

Sediment budget in  
direction of longshore  
drift on changi beach,  
singapore essay ...



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## Introduction

Changi Beach is one of the longest natural beaches in the north-eastern part of Singapore. The northern part of the beach is extended as a spit, a landform of coastal deposition. Spits are accumulations of beach material which result from longshore drift. Longshore drift is a process which causes beach material to move in a down-drift direction, due to waves approaching the beach at an oblique angle. This causes the swash to carry material in the direction of longshore drift, the process continuing such that material is transported along the beach. In the case of the spit at Changi Beach, longshore drift occurs in the north-west direction (refer to figure 1 and 2). Figure 3 illustrates the oblique angle at which the waves approach the beach.

This study aims to examine the development of the beach profile, with focus on the amount of beach material along the spit in the direction of longshore drift. While most studies would consider longshore drift along a beach, this study differs slightly as the beach face on the spit itself, as a landform of deposition, is being investigated. The gradient and length of the beach face can be hypothesised to increase in the direction of longshore drift, as the amount of the beach material contributes to a steeper and longer beach face. The increase of beach material along the beach can then be deduced using the gradient and length. According to Bird (2008) on beach budgets, conventional methodology can be used in this way to calculate differences in amount of beach sediment along the beach by looking at the cross sectional area of a beach profile.

This case study investigates the extent at which the hypothesis that the amount of material increases in the direction of longshore drift, is applicable to this spit. There may also be interesting findings on the amount of material in the area of the spit facing the channel leading to Changi Creek Reservoir. Even though such an investigation of how amount of sediment increases in the direction of longshore drift is seemingly tautological, according to Schwartz (2005) on longshore sediment transport, the phenomenon is regarded as “almost impossible to discern directly... and viewing the whole beach face does not provide any clues... only when transport rate changes along the shore, because of a barrier such as groin, does the beach change in a manner that can readily be detected.” As such, since preliminary analysis on-site seems to support the hypothesis that beach material does in fact accumulate in the direction of longshore drift, not only can this research examine the relationship of this concept of increase of beach material in relation to the gradient and length of the beach face, but also bring attention to a possibly unique situation on this particular depositional landform.

### Methodology

The gradient and length of the beach face was measured at several transects each 20 metres apart along the spit, from the area facing open waters, to the tip of the spit to the area facing the river. For the approximate location of these transects, refer to figure 5. The data was collected within five hours around the time of low tide.

At every two metres from the edge of the berm crest until one meter above the low tide level, the gradient of the slope was measured using two ranging poles and a clinometer (refer to figure 4). This procedure did not take into <https://assignbuster.com/sediment-budget-in-direction-of-longshore-drift-on-changi-beach-singapore-essay-sample/>

account breaks of slopes, which in the case of the beach face here, was negligible. The average of the values measured was calculated, deliberately leaving the value to 1 decimal place to analyse small differences along the spit, as the length of measurable area is short in comparison to other longer stretches of beach, and thus the difference in gradient is small between transects. This value is then taken to represent the overall gradient of the beach transect. The length of the beach face in metres was measured using a measuring tape from the berm crest to approximately one metre above the low tide level. The value was rounded off to the nearest 1 decimal place.

### Results and analysis

The gradients of transects each 20 metres apart are shown in figure 5. On the figure is also marked three areas on the beach, A to represent the area facing open water, B to represent the tip of the spit, and C to represent the area facing the channel. It can be seen that the gradient seems to increase generally in the direction of longshore, ignoring certain anomalies due to the small distance on which data is collected. It can also be observed that the part of the spit with the steepest gradient is at the curve of the spit facing the prevailing wind direction. This implies that longshore drift predominantly occurs at the stretch of beach facing the open sea.


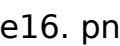
Refer to figure 6 for the lengths of the beach face taken to approximately a metre above the low tide level. It can be said that the increase in length along section A of the spit is comparatively more obvious than the increase in gradient angle, the values having fewer anomalies. It can be said

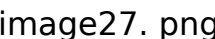
generally that the length of the beach face can be seen as possibly more

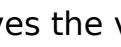
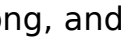


reliable a gauge of the direction of longshore drift than the beach gradient.

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Unlike the gradient of the beach, the longest beach faces can be found on the tip of the spit at section B.

These two values of gradient and length of the beach face can be used to mathematically calculate the cross-sectional area of each transect. While the resultant values may not be completely accurate, and the base of the cross-section is more or less arbitrary, and follows the mark used for measuring the length, observations can be made based on the differences between the values. Representing the gradient of the slope as  and the length of the beach as , the formula for calculating the cross sectional area is as follows (refer to figure 7):



The formula  gives the vertical height, represented on figure 7 as , and  gives the horizontal distance, represented as . The values were computed using MS Excel, refer to figure 8 for table. The values are represented on figure 9.

It is by looking at the resultant values shown on figure 9 that the effect of longshore drift on the amount of sediment on the spit becomes immediately apparent. The individual values of gradient and length do not show as clearly the amount of sediment, as both depend on the deposition of material at different places on the beach face, i. e. generally a steep gradient is caused by more material further up the beach face, and a longer beach is caused by more material deposited lower down the beach. It is interesting to note how in certain transects, for example the sixth transect from the east in section <https://assignbuster.com/sediment-budget-in-direction-of-longshore-drift-on-changi-beach-singapore-essay-sample/>

A, an abnormally steeper gradient has a shorter beach face. Thus, the calculated cross-sectional area provides a good gauge to the gradual increase of beach material in the direction of longshore drift, rather than relying on the individual values for gradient and length. The amount of beach material peaks at the transect marked by a cross on figure 9, and starts to decrease at the tip of the spit. It can be deduced that material is transported along section A by the prevailing winds from the northeast to the tip of the spit facing the open sea.

There is comparatively lesser beach material at section C of the spit. Facing a narrow channel which does not have much of an immediately observable current on its own, analysis can proceed with an assumption that the amount of material transported into the area by the channel further upstream is negligible. It can be said that the amount of beach material can be seen to be decreasing from section B to C. As longshore drift occurs primarily along the length of beach facing the open sea, only the curve of the spit nearer to section A receives the bulk of beach material. The tip of the spit at B seems to as a whole have more material than the other sections. The amount of beach material decreases along section C of the spit until the transect marked with a circle in figure 9. Following that, the presence of a manmade stone wall causes accumulation of sediment, thus both the gradient and length of the beach face increases (refer to figure 10). It is interesting to note that while this area is against the predominant direction of longshore drift, since longshore drift acts mainly on section A, the situation along section C is rather different.

This channel of water can be characterised as mainly calm, as it does not receive the waves, situated away from the predominant directions of wind. Still, a small degree of longshore drift can be seen to occur, away from the assumed direction of longshore drift, which can now be concluded as applicable only in section A. Longshore drift at C occurs to a certain extent due to passing boats which create waves that approach the beach at many directions. A weak swash and backwash can be observed parallel to the beach when boats do not pass the channel. While the focus of most studies should be on natural waves, a certain degree of longshore drift does in fact occur at section C. In order to represent the actual situation at this section of the spit, human factors have to be taken into consideration. Refer to figure 11 and 12.

## Conclusion

There are several limitations to this study. Firstly, as measurements to do with the length of the beach face was done as the tide was falling or rising, estimations had to be continually made for each transect as to how much the tide level had changed. Also, the lack of a long stretch of beach made it necessary to not disregard any small changes in beach gradient between transects, which would usually be considered negligible. Furthermore, the accuracy of the measurements may be hindered by a variety of factors such as human error when taking gradients, and measuring a transect that is not fully perpendicular to the berm crest.

In this study, no concrete measurements were taken to form a complete picture of how the beach profile changes in the direction of longshore drift, and calculations were made only based on the beach face as a whole.

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Preliminary observation seems to suggest that the phenomenon of longshore drift has an effect on the location and length of the berm. Section A can be characterized by a marked, flat berm and a sudden slope at the storm beach, while the berm seems to be less obvious progressing in the direction of the tip of the spit; in section B the berm is steeper and the storm beach is longer (refer to figure 13 and 14). In fact, the lack of an actual berm in section C led to a small amount of confusion when taking the readings for the length of the beach face. Future research could consider the effect of longshore drift of the beach profile of the spit as a whole.

It can also be said that the idea that both length and gradient of the beach increases in the direction of longshore drift is true, though to interpret it another way, it would be more of the case that, due to increase of material, the beach face is thus steeper and longer. In conclusion, though the effect of longshore drift on gradient and length is not always clear, but these factors, as well as the calculation of the cross sectional area based on the values; have been proven to be reliable in estimating the differences in amount of beach material.

The hypothesis that beach material increase in the direction of longshore drift has been proven to occur on the coastal depositional feature of a spit. The amount of beach material increases along section A and accumulates at the tip of the spit. It is likely that with the continual process of longshore drifting, section A would continue to extend in the future. Further studies are required to fully understand whether the hypothesis of beach material increasing in the direction of longshore drift is in fact exclusive to spits, as highlighted in the introduction on the fact that change to the beach face in <https://assignbuster.com/sediment-budget-in-direction-of-longshore-drift-on-changi-beach-singapore-essay-sample/>



the direction of longshore drift is not normally observable. Possibly, this is a unique case where changes in the beach face are observable in the direction of longshore drift.

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