CHAPTER 84

FIELD STUDY OF SURATHKAL BEACH

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ABSTRACT

Beach profile observations and sediment sampling were carried out for six months at frequent intervals to study the seasonal changes of the beach. The study is helpful in bringing out the qualitative and quantitative changes of the beach under varying wave and tide conditions. Useful information is obtained and presented regarding i) the maximum rate of erosion ii) the total quantity of material eroded iii) the critical wave steepness values which changed from depositing to eroding nature and iv) the sediment characteristics of the beach.

INTRODUCTION

This paper presents the results of a six month (February to August 1969) field study of the seasonal profile changes and sediment characteristics of a natural sand beach at Surathkal.

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Surathkal beach is on a straight reach of the West Coast of India facing the Arabian sea at a distance of 20 Km north of Mangalore. The beach material is well sorted sand having median diameters in the range of 0.2 to 0.4 mm. The climatic conditions on the coast repeat annually with remarkable regularity and uniformity. The beach is exposed to relatively uniform swells of low steepness arriving with crests parallel or nearly parallel to shore during fair weather season when the beach is built up. During the monsoon period, the wave height and the wave steepness are increased and the beach is eroded. The average tidal range is about 1 metre.

Beach erosion problems exist along some stretches of West Coast of India and the information obtained from this study could be useful in planning shore protection measures.

FIELD MEASUREMENTS AND OBSERVATIONS

i) Beach profiles:-

A stretch of beach of 200 metres length was selected for study and observation. Three cross sections, 100 metres apart, were marked by constructing two pillars for each section. The pillars were constructed on the storm berm where the waves do not normally reach. The line joining the three pillars nearer the water line was taken as the base line.

Levelling was done using a precise level along the three cross sections on the portion of the beach exposed at

low tide between the base line and the water line. The beach elevations given in the various figures are with respect to an arbitrary datum. Profile measurements were done at intervals of 3 to 9 days, the interval depending on the magnitude of the changes that occured. A total of 33 measurements were made during six months. Surface sediment samples at various points along the profiles were collected during some of the observations.

ii) Wave and Tide data:

Wave data was obtained from the wave records of the offshore subsurface pressure type wave recorder installed by the Mangalore Harbour Project authorities at Panambur about 10 Km. south of Surathkal beach. The waves were recorded for 15 minutes at 3 hour intervals during fair weather season and at closer intervals during monsoon period.

The maximum recorded wave heights and the corresponding periods for each day were available from the records. The maximum surface wave heights for each day were computed by using the corresponding pressure response factors.

For the periods of considerable changes in the beach profiles, the continuous wave records for the days were studied and representative strips, each of 15 minute duration, were analysed to find out the mean wave heights and the average periods. The surface mean wave height was computed and the corresponding deepwater mean wave height

had the same value as this because the shoaling and refraction coefficients were both nearly equal to unity for the prevailing conditions. The deepwater mean wave steepness was computed using the deepwater mean wave height and the deepwater wave length corresponding to the average period. Visual observations were also made to study the type and location of the breakers and width of surf zone.

The tide data was obtained from the tide recorder installed by the Mangalore Port authorities at Mangalore. The tidal range can be taken to be the same at Mangalore and Surathkal.

RESULTS OF STUDY

i) Seasonal beach profile changes:-

The period of study covered two distinct portions of the year. One was the premonsoon fair weather season upto middle of May when the beach was still being built up by processes of deposition which commenced at the end of the previous year's monsoon. The second one was the monsoon period from middle of May to August when the beach was eroded. After August the beach would again slowly start building up. The climatic conditions on the Coast repeat annually with remarkable regularity and hence the corresponding beach processes are also more or less repetitive in nature. Thus the study included the period when the beach process changed from depositional to eroding nature and the period when the total erosion

occured.

Typical beach profile changes at one of the three cross sections are shown in figure 1. upto about the middle of May, the beach was subjected to long period waves of low steepness and was being built up. The maximum wave height was less than one metre and the mean wave steepness was less than 0.002. The height and width of the summer berm increased to a maximum and the berm had a slope towards the land.

Fig.2 shows the beach profile changes during the period of erosion from middle of May to August. It is not as if there was continuous erosion during the period. There were periods of deposition in between but the net effect was one of erosion. The complete summer berm was progressively eroded.

During the latter half of May there was a gradual increase in the maximum wave height from less than one metre to about 1.75 metres. The mean wave steepness also increased from about 0.002 to 0.003 and above as shown in fig.4. This is the period when the beach erosion has set in as can be seen from the beach profiles on 20th and 28th May in fig.2. Therefore the critical deepwater mean wave steepness value which changed the wave action on the beach from depositing to eroding nature lies between 0.002 and 0.003.

The maximum rate of erosion occured during the period 28th May to 5th June. The beach profiles at one

of the sections are shown in fig.3. Similar profile changes occured at all the three cross sections. During this period the maximum wave height increased to about 2 metres; the mean wave steepness increased to 0.004; and this happened to be the spring tide period with an increased tidal range. It was computed from the three cross sections that, on an average, 15.8 metres width of berm was removed and 18.65 cu. metres of material per metre length of beach was eroded during this period. This gives a maximum rate of erosion of 1.18 cu.metres of material per sq.metre change in beach surface area in one week (i.e. 0.143 cu yds/ft^2/week)

Fig.5 shows two profiles at one of the cross sections. One profile corresponds to the stage of maximum deposition and the other one to that of maximum erosion. From similar profile changes at the three sections, the total quantity of material eroded during the season was an average of 74 cu. metres per metre length of the beach and the average width of beach eroded was 31 metres. One sq.metre of change in beach surface area equals 2.39 cu. metres of beach material eroded (i.e. 1 sq.ft. of change in beach area equals 0.3 cu.yds.of material eroded). This, it may be observed, is a much smaller value compared to other exposed beaches in the world.

From such profile changes as shown in fig.5 it was also found that the active zone of the beach, the material of which partook in the beach processes, was confined to

a depth of about 3 metres.

Figs.6 and 6(a) show the profile changes at two of the cross sections. The beach profiles appeared to oscillate in response to a tidal cycle of about a month's duration. The profiles did not repeat exactly as the wave characteristics had not remained the same throughout the period.

Cusps were found to form on the beach during periods of deposition as well as erosion. They always formed during the neap tide periods and disappeared during the subsequent spring tides. The spacing of the cusps along the beach was regular and varied from 27 to 45 metres. The spacing of the cusps and the level difference between the valley and the ridge of the cusp formation increased with increase in wave height.

ii) Sediment Characteristics:

The median diameter of the beach sand was between 0.2 and 0.4 mm. The dune sand was finer than that on the berm. The sands on the dunes, berms and the foreshore were all well sorted with the sorting coefficient lying between 1.1 and 1.4. The grain size distributions were nearly symmetric with the skewness values lying between 0.9 and 1.1. There was no regular variation of median diameter with depth at a point on the beach and also along the beach at various points.

Relationship between grain size (median diameter in mm) and the foreshore slope on which it was resting is shown in fig.7. The curve is inserted in a similar plot given in

reference number 1 for comparison with other coasts. Sand of a given size within the range of 0.2 to 0.4 mm stands on a steeper slope on this beach.

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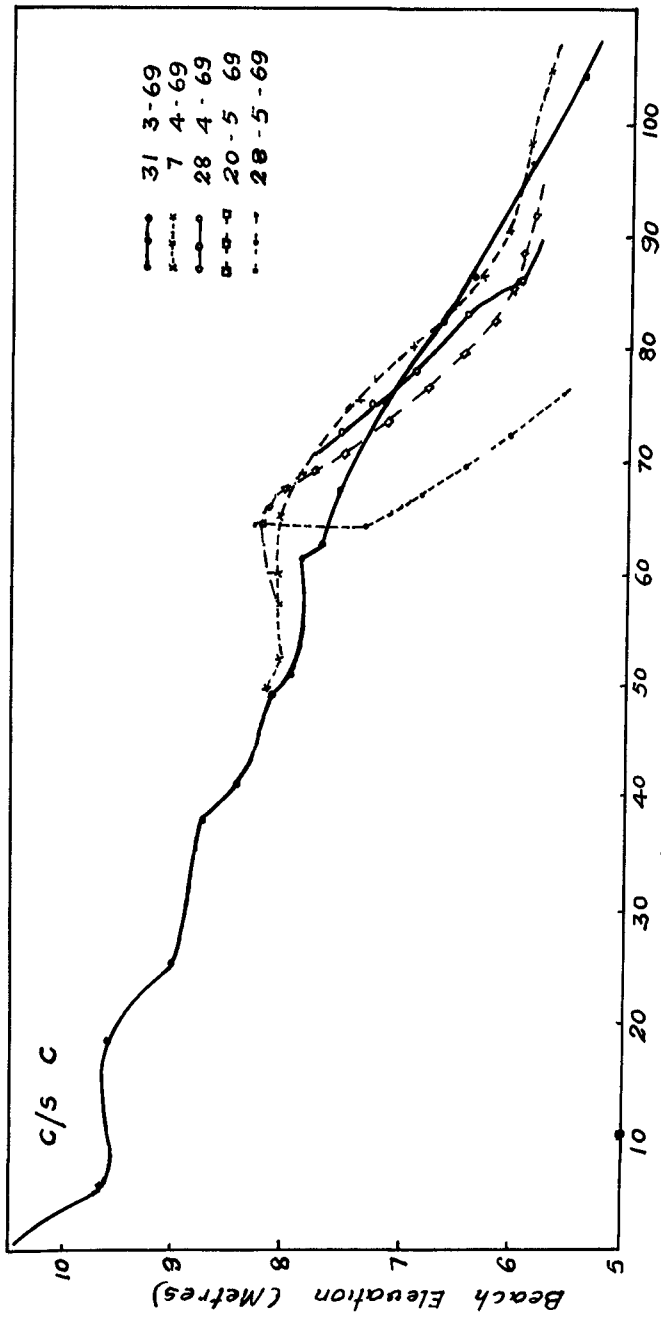

Fig 1. STAGES OF DEPOSITION

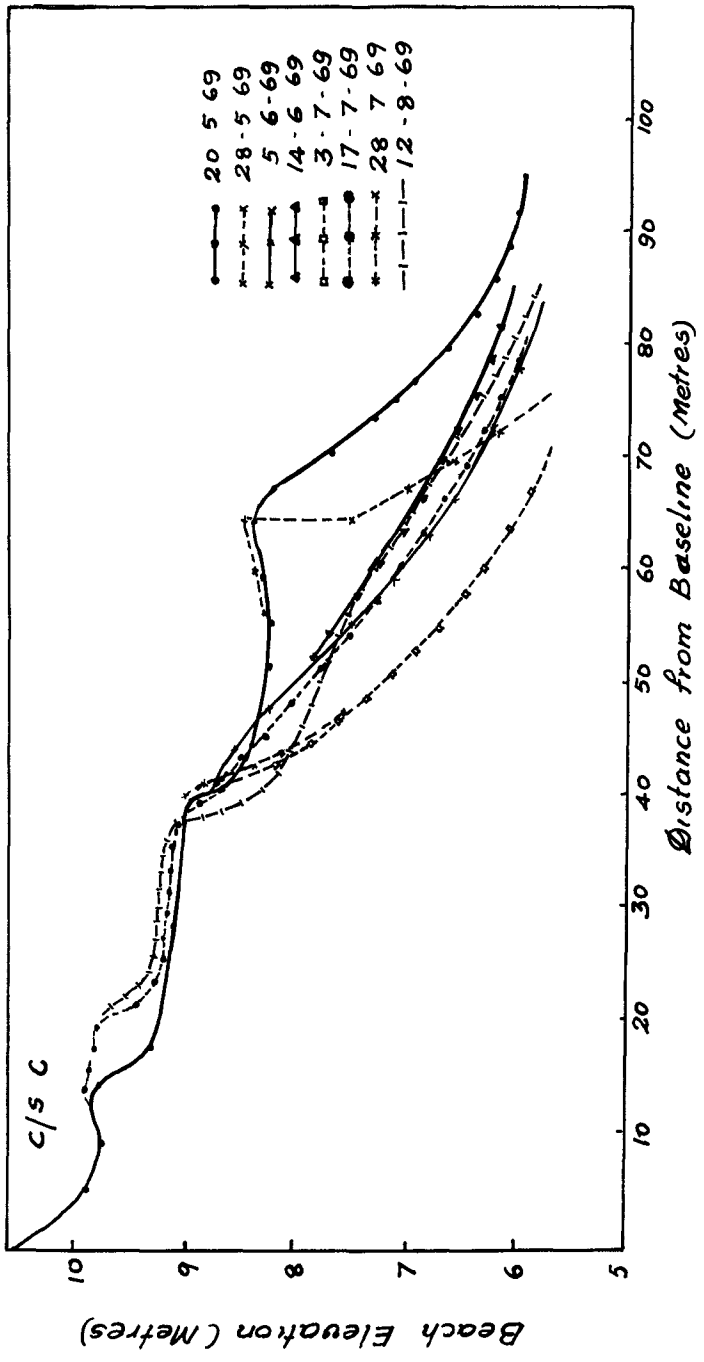

Fig 2 STAGES OF EROSION

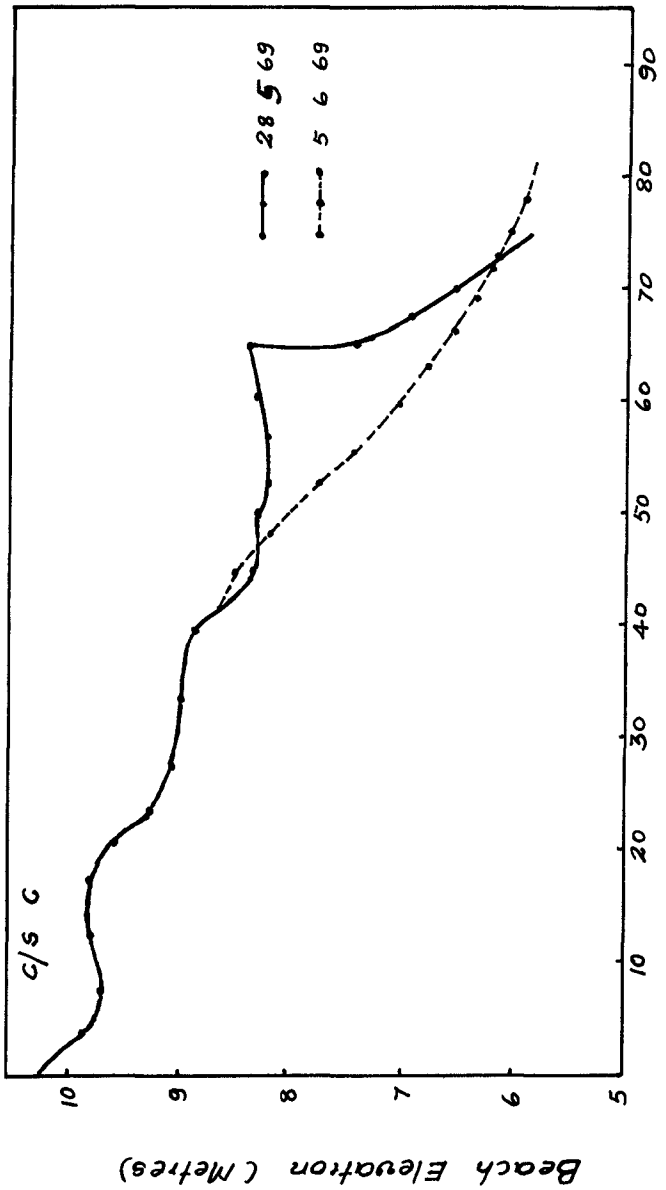

Fig 3 MAXIMUM RATE OF EROSION

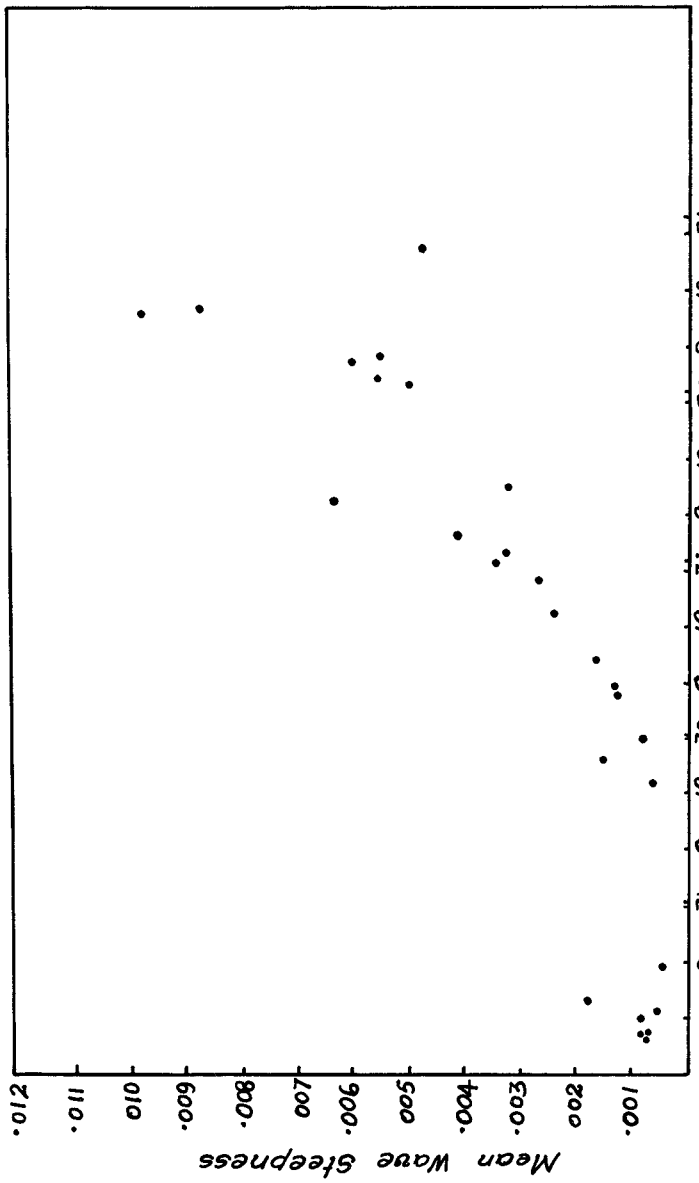

Fig 4 VARIATION OF MEAN WAVE STEEPNESS

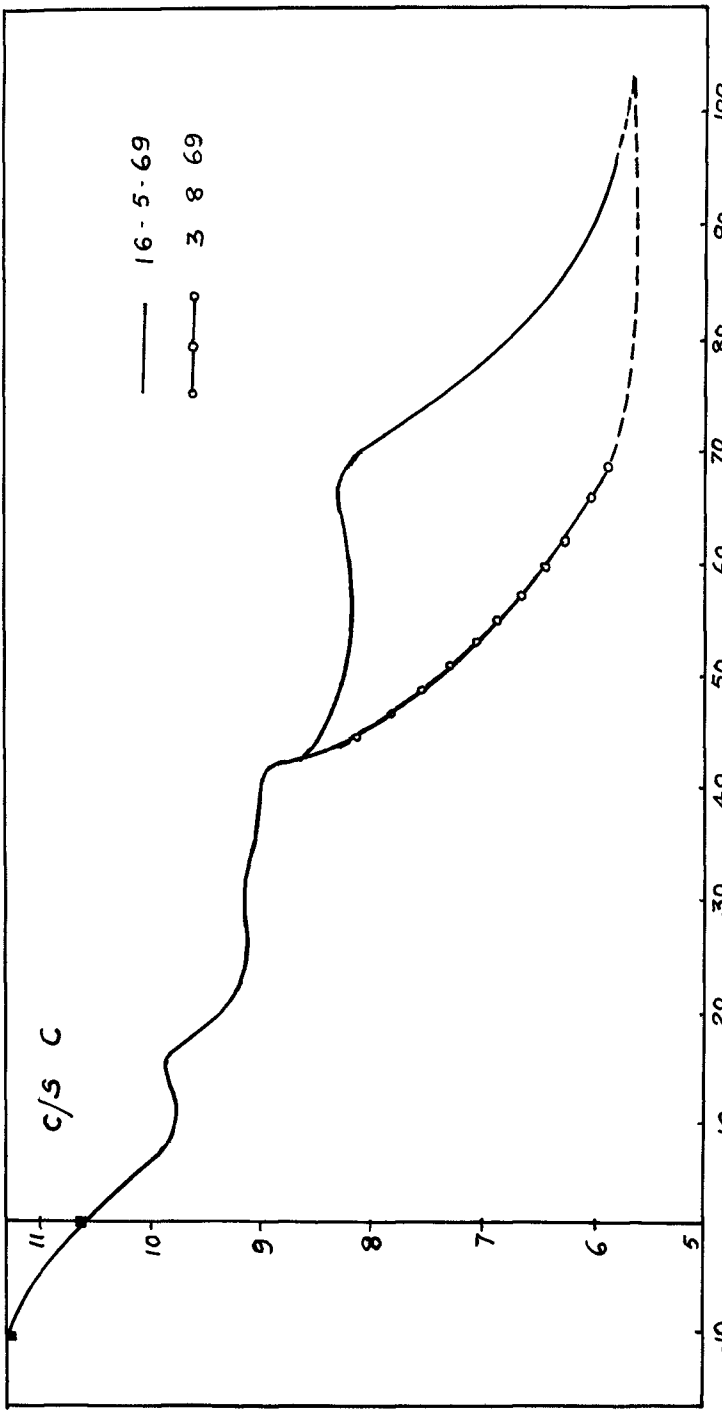

Fig 5 MAXIMUM EROSION

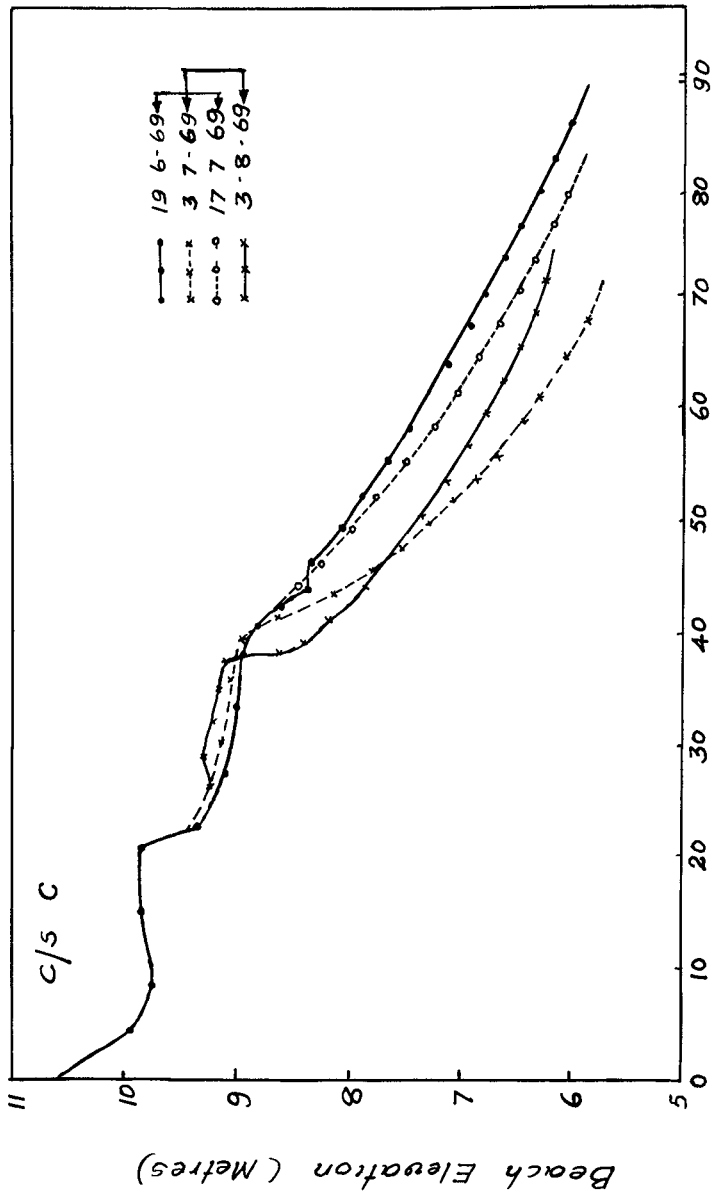

Fig 6 RESPONSE TO TIDAL VARIATION

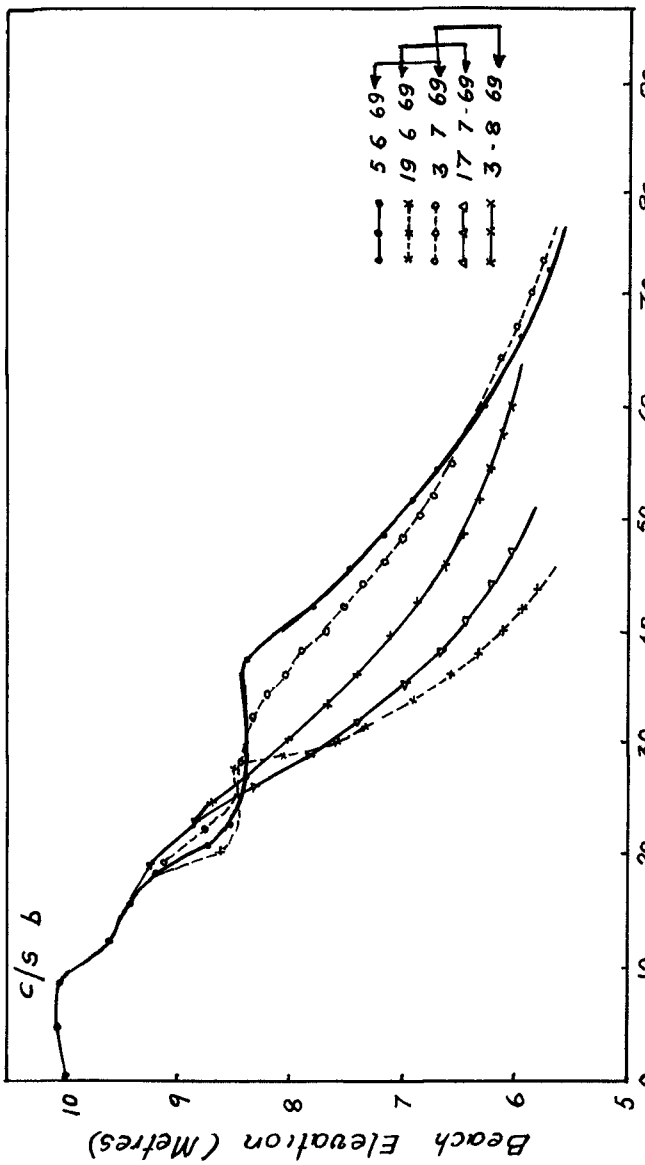

Fig 6(a) RESPONSE TO TIDAL VARIATION

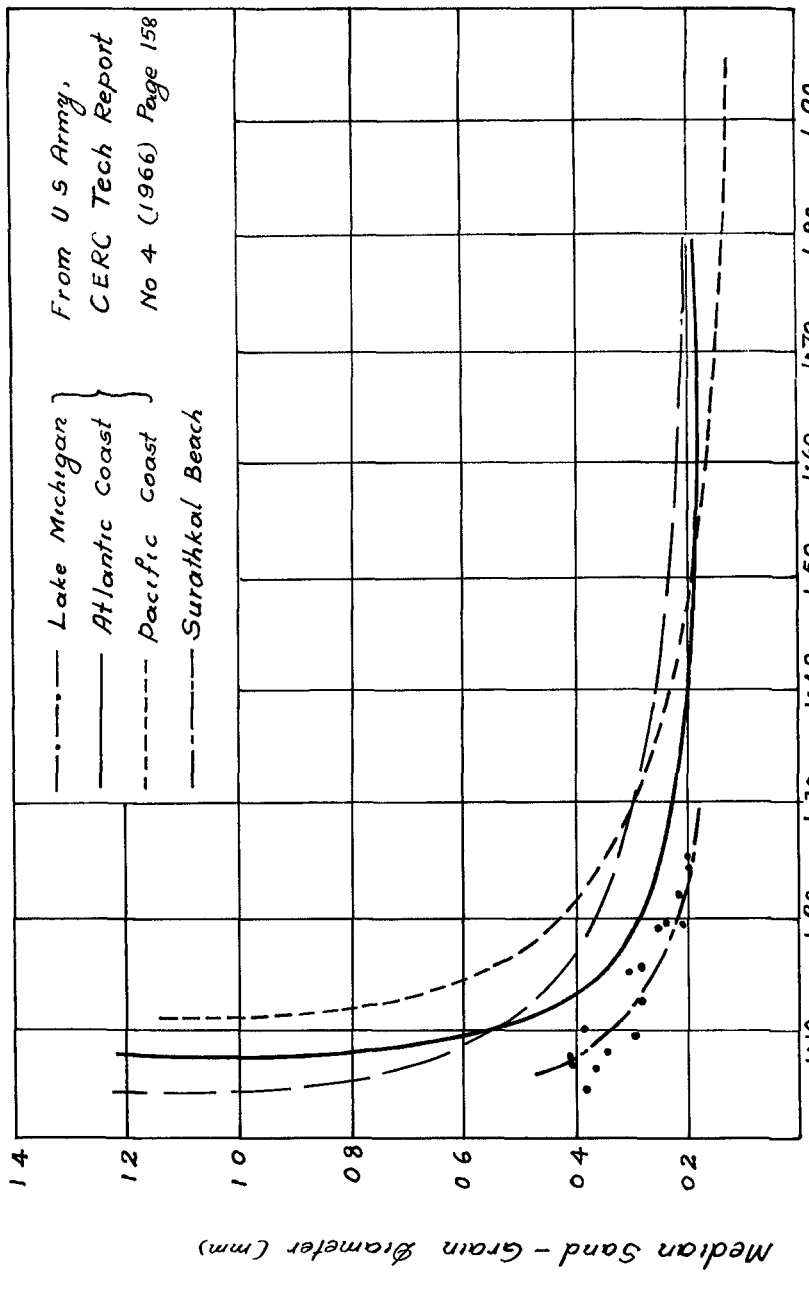

Fig 7 RELATIONSHIP BETWEEN GRAIN SIZE AND FORESHORE SLOPE