CHAPTER 67

THE EFFECT OF GROYNES ON ERODED BEACHES

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ABSTRACT

Laboratory tests are described, in which the effect of impermeable groynes on an eroded beach was studied A beach was allowed to reach equilibrium for a particular wave climate and supply of littoral material The foreshore was then manually eroded, and the beach allowed to return to equilibrium with and without groynes It was found that the presence of groynes increased the rate of accretion but did not significantly build up the inshore beach beyond the stable levels Bed levels seaward of the groynes were increased

Introduction

As part of the continuing research into the effects of groynes on beaches being carried out at the Hydraulics Research Station, the authors presented a paper to the 11th Conference on Coastal Engineering, see Ref 1, describing laboratory tests to study the effect of permeable and impermeable groynes on a beach that was stable for a particular wave climate and a given supply of littoral material These tests showed that on the part of the beach between high water and low water levels the groynes induced little or no build-up However, accretion was found seaward of the impermeable groynes It was concluded that this offshore build-up was necessary in order that, at equilibrium , the littoral transport that formerly travelled along the foreshore could pass seaward of the groynes The permeable groynes tested had little effect on either inshore or offshore levels

Since then, the more practical case of groynes installed on an eroded beach has been studied The tests were conducted in the same wave basin as the previous series, see Fig 1 This facility allows the generation of waves at an angle to the beach using the serpent-type wave generator shown plus tides and littoral currents, although the littoral current

generator was not used during these tests

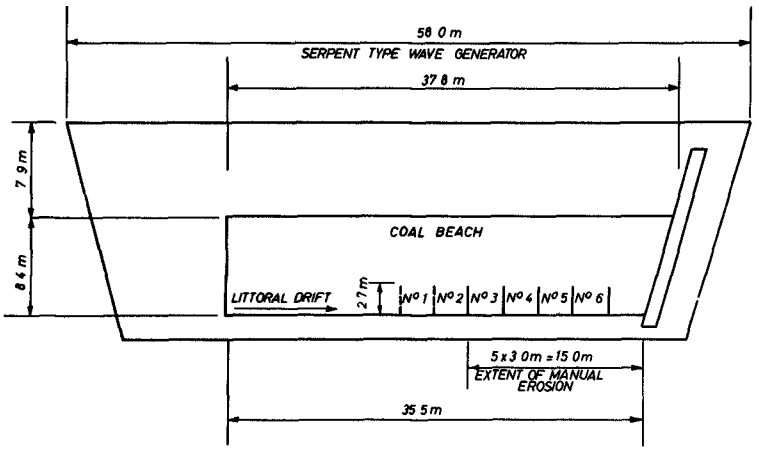

FIG 1 DETAILS OF WAVE BASIN

Test Procedure

In the absence of groynes, waves and tides were generated to bring the beach to equilibrium The waves were 65 mm high at mean water level, with a period of 1 15 seconds and an angle of approach of 5 degrees in deep water The tidal period was 75 minutes, with a range of 0 12 m Beach material was crushed coal of specific gravity 1 35 and median grain size 0 8 mm The experiments were continued until a comparison of successive beach surveys showed that little change was taking place and the quantity of littoral material trapped at the downdrift end of the beach was the same as that fed in at the updrift end, this normally required at least 25 tides

An eroded beach, 15 m long, was then created at the downdrift end by removing material between high and low water to an average depth of 25 mm Five impermeable groynes were placed on the eroded beach The groynes, shown as solid lines in Fig 1, were 2 7 m long and about 35 mm high, spaced at 3 0 m, 1½ times the horizontal distance from high water to low water

Again the same waves and tides were generated and the littoral transport measured. Beach material was fed to the updrift beach at the average rate measured on the equilibrium

beach Beach surveys were made at 1, 3, 5, 10, 15 and 20 tides, at which time the beach had returned to its equilibrium profile

The experiment was then repeated with no groynes on the eroded beach

Calculation of Results

The parameter selected for the comparison of beaches was the volume of coal within groyne compartments The six compartments for which volumes were calculated are defined in Figs 1 and 2, all compartments were 3 0 m long, 2 7 m wide and a maximum of 0 28 m deep

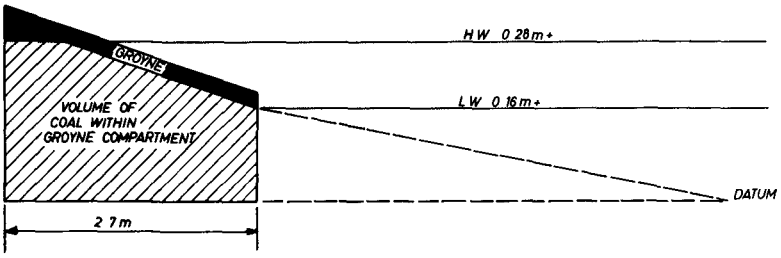

FIG 2 BEACH ZONE REFERRED TO IN CALCULATIONS

Although not bounded on both sides by groynes, compartments 1 and 2 were included to show the effect of groynes on the updrift beach

Three cross-sections were measured in each compartment 0 15 m from the groynes or boundaries, and on the compartment centre-line Volumes were then calculated using the trapezoidal rule These volumes were plotted in Fig 3

(i) Stable beach without groynes

(ii) Eroded beach without groynes after 1, 3, 5, 10, 15 and 20 tides

(iii) Eroded beach with groynes after 1, 3, 5, 10, 15 and 20 tides

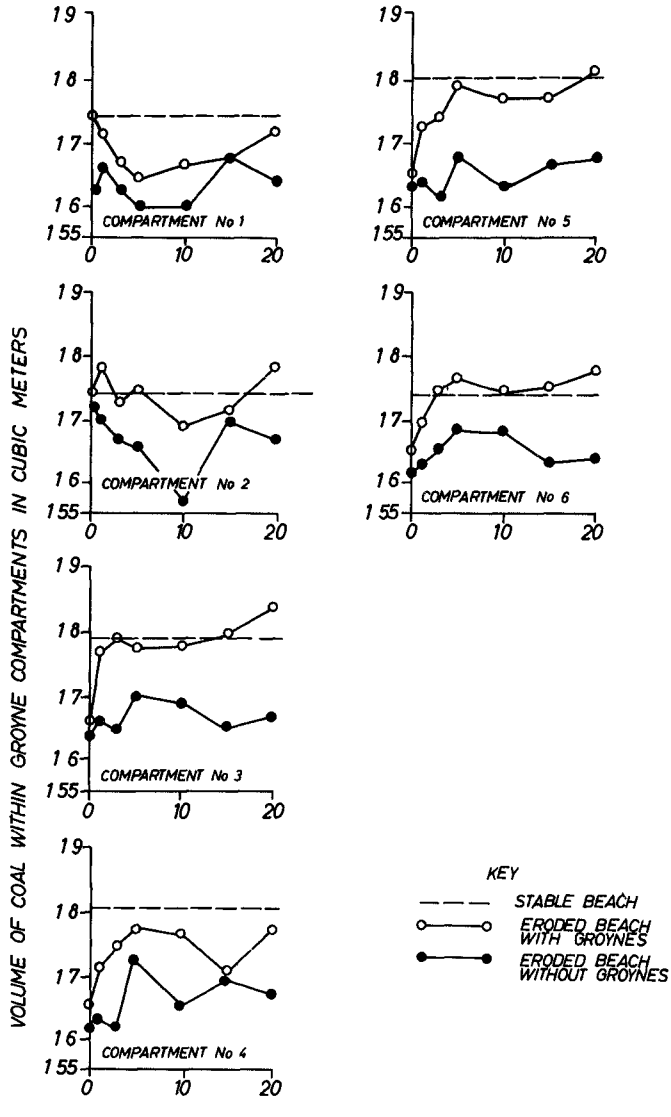

FIG 3 BEACH CHANGES WITH TIME

Interpretation of Results

The changes with time in the volumes of material in each compartment with and without groynes can be seen in Fig 3 In addition, the volumes for the stable beach, before manual erosion, are indicated

Clearly, the rate of accretion in the groyne compartments, Nos 3, 4, 5 and 6, was greater in the presence of groynes This increased rate of inshore accretion was accompanied by a build-up in bed levels offshore of the groynes, not shown in Fig 3, necessary in order that at equilibrium the littoral transport that formerly travelled along the foreshore might travel seaward of the groynes With groynes, the beach had returned to its equilibrium profile in approximately 20 tides, without groynes, the experiment was terminated at 20 tides since it was clear that the beach was returning to the equilibrium profile, although slowly

No significant build-up of the groyned beach was found above the stable levels, with the exception of the accretion already mentioned seaward of the groynes

Conclusions

The following conclusions might be drawn from the results of the present series of tests

1 Groynes will increase the rate of accretion on an eroded beach if there is a sufficient supply of littoral material

2 The presence of groynes will not result in a build-up of the inshore beach above the stable open beach levels for the given wave climate and supply of littoral material

3 Bed levels seaward of groynes will be increased in order that a uniform littoral drift may be maintained along the coast

Acknowledgement

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1 PRICE, W A and TOMLINSON, K W "The effect of groynes on stable beaches" Proc 11th Conf on Coastal Engineering, 1968, Vol 1