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Effects of T-shape groin parameters on beach accretion

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Abstract

The effects of various groin parameters (length, head length and opening) and wave parameters (wave height, wave period and wave angle) on the accretion of the area protected by T-shape groins are studied in a physical model. The model studies are performed using regular waves in a basin. A numerical model which depends primarily on a CERC model is employed to examine the effects of some of the above parameters. Good agreement is found in the results of physical and numerical models. The results of a numerical model are compared with field data obtained by deep sounding measurements at Of coasts, Trabzon Province, Turkey. The finding from this study may be employed in designing T-shape groins.

Keywords: Groins; Shore protection; Sediment transport; Accretion parameter; Numerical model; Field data

1. Introduction

Historically (say, for thousand of years), a coastal region, without any structure, could be in equilibrium from the sediment regime. A seasonal sediment transport

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depending on dominant wave conditions and directions may be varying from one region to another. The net sediment transport is defined as the summation of cross-shore and long shore transport $Q_N = Q_{CR} + Q_{LR}$, where the cross-shore transport consists of offshore transport, Q_{off}, and onshore, Q_{on}, i.e., $Q_{CR} = Q_{off} + Q_{on}$. Long shore transport has components directed to the left, Q_L, and to the right, Q_R, leading to net transport $Q_{LR} = Q_L + Q_R$; where Q_L is taken as negative. Balance in sediment budget is disrupted by the construction as a coastal structure, dredging of sediment for navigation channel, etc.

A groin is a shore protection structure designed to trap littoral drift and, to some extent, the cross-shore sediment for creating a protective beach, retarding erosion of an existing beach, or preventing long shore drift from reaching some downdrift point, such as a harbor or inlet. Groins are narrow structures of variable lengths and heights and are usually constructed in perpendicular to shoreline. Groins can be constructed as a single structure or in series (groin field).

Several investigations have been conducted in the past to study the effect of groin parameters on beach accretion. Some of the most important studies and their conclusions are summarized as follows.

Press (1962) performed physical model studies on straight groins and recommended some criteria about the accretion amount and groin opening.

Price and Tomlinson (1968) conducted a study on the effects of groins on stable beaches and studied the coastal changes for various groin parameters, using a three-dimensional physical model. The effect of the groins on the beach was similar for the different wave angle ($\alpha = 20, 5°$) and for the fixed groin spacing.

Brampton and Goldberg (1991a,b) studied the effects of groins on shingle beaches on the beach evolution, using a three-dimensional physical model. They studied a shore with three groins, and after 10 yearly observations they found that the accretion at the updrift side of groins was equal to the erosion at the downdrift side.

Hanson and Kraus (1991) experimentally studied the effects of a series of three groins on shore evolution and proposed a numerical model (GENESIS) and concluded that this model was in agreement with the findings of the physical model.

Moutzouris (1992) studied the erosion problem derived from the construction a fishery harbor. At the end of a series of physical models, he proposed the construction of six groins and observed that, field data obtained after the construction of the groins were in a good agreement with the physical model results.

Kraus et al. (1994), who carried out physical model studies on groin parameters, proposed that groin length be equal to groin opening.

Güngördü and Otay (1997) proposed a numerical model to calculate the shoreline changes in the vicinity of a groin employing only long shore sediment transport and compared their model with field data obtained from four yearly observations.

Leont'yev (1997), in this study, the proposed numerical simulates the short-term temporal changes in shoreline position due to a structure interrupting the long shore sediment flux. The impacts of the groin-type construction and under water trench of arbitrary orientation relative to the shore are investigated and he tested the model against the laboratory data of Baidei et al.