Available online at www.sciencedirect.com
SCIENCE DIRECT®
Coastal Engineering 49 (2003) 125–153
Coastal Engineering
An International Journal for Coastal, Harbour and Offshore Engineers
www.elsevier.com/locate/coastaleng

Wave field modification by bathymetric anomalies and resulting shoreline changes: a review with recent results

Christopher J. Bender*, Robert G. Dean

Taylor Engineering, 9000 Cypress Green Drive, Jacksonville, FL 32256, USA

Received 4 July 2002; received in revised form 21 May 2003; accepted 20 June 2003

Abstract

This paper provides a review of available studies on wave transformation by bathymetric changes and the resulting shoreline impacts. Three case studies of beach nourishment projects with significant nearshore borrow areas are examined: Grand Isle, Louisiana constructed in 1984, Anna Maria Key, Florida in 1993, and Martin County, Florida in 1996. A review is presented of field and laboratory scale studies that have examined the impact of offshore pits on the local wave field and sediment dynamics. Solutions for wave transformation by changes in bathymetry are outlined primarily in chronological order following the development from analytical solutions for long waves in one horizontal dimension (1-D) through numerical models for arbitrary bathymetry that include many wave-related nearshore processes. Modeling of shoreline responses due to wave field modification owing to changes in offshore bathymetry is examined with models that include both wave field and shoreline changes and by coupling models that evaluate these processes independently. The wave transformation processes included in nearshore models are important factors in the capability to predict a salient leeward of a pit; the shoreline responses observed in the limited laboratory experiments and at Grand Isle, LA.

Keywords: Wave transformation; Borrow pit; Beach nourishment; Bathymetric anomaly; Dredging

1. Introduction

Modifications of offshore bathymetry by removal of large quantities of sediment alter the local wave field, which in turn modifies the equilibrium planform of the leeward beach. These effects as well as the impact on sediment dynamics near the sediment removal area have become of concern as the extraction of offshore sediment for beach nourishment, construction materials, and other purposes has increased. Unexpected shoreline planform changes in and adjacent to completed beach nourishment projects have been attributed to offshore borrow pits. Thus, a better understanding of the effects of bathymetric changes on the wave field and the resulting impacts on shorelines would be beneficial to more appropriate utilization of offshore sand resources.

Several studies encompassing field and laboratory scales have been conducted to investigate this issue. These studies have examined wave transformation over a bathymetric anomaly with the shoreline changes caused by the altered wave field. Initially, dating back to the early 1900s, the focus was on the modification of a wave train encountering a change in bathymetry.

* Corresponding author. Fax: +1-904-731-9847.
E-mail address: cbender@taylorengineering.com (C.J. Bender).

0378-3839/03/$ - see front matter © 2003 Elsevier B.V. All rights reserved.
doi:10.1016/S0378-3839(03)00061-9