

COASTAL ENGINEERING

Santa Barbara
Specialty Conference
October, 1965



J. A. Battjes

COASTAL ENGINEERING

Santa Barbara
Specialty Conference
October, 1965



AMERICAN SOCIETY OF CIVIL ENGINEERS
345 E. 47TH STREET
NEW YORK, N.Y. 10017

Price \$10

COPYRIGHT 1966
By The American Society
of
Civil Engineers

NOTE— The society is not responsible for
any statement made or opinion
expressed in this publication.

ACKNOWLEDGMENTS

This conference was sponsored by the Waterways and Harbors Division of the American Society of Civil Engineers through its Committee on Coastal Engineering. Appreciation is expressed to the Los Angeles Section, ASCE, and in particular to William J. Herron, Jr., M. ASCE, for their assistance, particularly in providing programs and funding arrangements; to the Santa Barbara - Ventura Counties Branch of the Los Angeles Section, ASCE, and, in particular to Wallace C. Penfield, M. ASCE, Chairman of the Local Arrangements Committee, for dealing with the meeting arrangements; and to the U. S. Army Engineer District, Los Angeles, for photographs supplied to illustrate the cover and the section title pages of this publication.

All of the material from this conference was compiled by Thorndike Saville, Jr., M. ASCE. Without his outstanding organizational effort and diligence this publication would not have been possible.

CONTENTS

PART 1. WAVES, WAVE CHARACTERISTICS, AND WAVE FORCES

chapter 1

[ORTHOGONAL COORDINATES FOR THE ANALYSIS OF LONG GRAVITY WAVES NEAR ISLANDS](#)

R. O. Reid and A. C. Vastano

1

chapter 2

[HILO HARBOR TSUNAMI MODEL - REFLECTED WAVES SUPERIMPOSED](#)

Robert Q. Palmer, Michael E. Mulvihill and Gerald T. Funasaki

21

chapter 3

COAST AND GEODETIC SURVEY TSUNAMI PROPAGATION PROGRAM ([abstract only](#))

Gaylord Miller

33

chapter 4

[STRUCTURAL DAMAGE BY TSUNAMIS](#)

Orville T. Magoon

35

chapter 5

[WATER WAVES GENERATED BY UNDERWATER EXPLOSIONS](#)

Jan M. Jordaan, Jr.

69

chapter 6

[PRACTICAL USE OF ELECTRIC NETWORKS TO SIMULATE OR PREDICT SEICHE CONDITIONS IN HARBORS](#)

Joseph W. Joy

87

chapter 7

[LONG PERIOD OSCILLATIONS IN BASINS OF ARBITRARY SHAPES](#)

Frederic Raichlen

115

chapter 8

[THE SPECTRAL DENSITY FOR OCEAN WAVE FORCES](#)

Leon E. Borgman

147

chapter 9	
<u>ON THE PROBABILITY DISTRIBUTION OF WAVE FORCE AND ON INTRODUCTION TO THE CORRELATION DRAG COEFFICIENT AND THE CORRELATION INERTIAL COEFFICIENT</u>	
Charles L. Bretschneider	183
chapter 10	
<u>FIFTH AND FIRST ORDER WAVE FORCE COEFFICIENTS FOR CYLINDRICAL PILES</u>	
Hans A. Agershou and J. J. Edens	219
chapter 11	
<u>FORCES ON A FLEXIBLE PILE</u>	
A. D. K. Laird	249
chapter 12	
<u>STREAM FUNCTION WAVE THEORY; VALIDITY AND APPLICATION</u>	
Robert G. Dean	269
chapter 13	
<u>A HIGHER ORDER THEORY FOR DEEP WATER WAVES</u>	
Peter L. Monkmeyer and John E. Kutzbach	301
chapter 14	
<u>ON FROUDE-CAUCHY SIMILITUDE</u>	
B. Le Mehaute	327
chapter 15	
<u>DEFORMATION OF SOLITARY WAVES ON A 45-DEGREE SLOPE</u>	
Norman Wallace	347
chapter 16	
<u>WIND EFFECT ON PRE-EXISTING WAVES</u>	
Groshon Kulin	369
chapter 17	
<u>THE INFLUENCE OF WIND ON OPEN CHANNEL FLOW</u>	
Erich J. Plate and Carl R. Goodwin	391
chapter 18	
<u>WAVE ATTENUATION IN A CHANNEL WITH ROUGHENED SIDES</u>	
J. S. Battjes	425

chapter 19	
<u>WAVE STATISTICS FROM HURRICANE DORA AT PANAMA CITY, FLORIDA</u>	
J . Ian Collins	461
chapter 20	
<u>GROWTH OF LONGSHORE CURRENTS DOWNSTREAM OF A SURF- ZONE BARRIER</u>	
Peter S. Eagleson	487
PART 2. SHORE PROCESSES AND SEDIMENT MOVEMENT	
chapter 21	
PREDICTOR EQUATIONS FOR BEACH PROCESSES AND RESPONSES (<u>abstract only</u>)	
Wyman Harrison	509
CHAPTER 22	
<u>LITTORAL PROCESSES AND THE DEVELOPMENT OF SHORELINES</u>	
Douglas L. Inman and Jeffery D. Frautschy	511
chapter 23	
<u>NEARSHORE SEDIMENT MOVEMENT - CENTRAL CALIFORNIA COAST</u>	
J. W. Johnson	537
chapter 24	
<u>BY-PASSING AND BACKPASSING WITH SPECIAL REFERENCE TO CONDITIONS IN FLORIDA</u>	
P. M. Bruun	561
chapter 25	
<u>SHELL DREDGING AS A FACTOR IN ESTUARINE SEDIMENTATION</u>	
Frank D. Masch	627
chapter 26	
<u>EROSION AND ACCRETION ALONG CLATSOP SPIT</u>	
Harold A. Kidby and John G. Oliver	647
chapter 27	
<u>STUDY OF EROSION ALONG HOMER SPIT AND VICINITY</u>	
Gail J. Gronewald and Walter W. Duncan	673

chapter 28	
<u>MEASUREMENT EQUIPMENT AND TECHNIQUES USED IN STUDY- ING RADIONUCLIDE MOVEMENT IN THE COLUMBIA RIVER ESTUARY</u>	
Edmund A. Prych, D. W. Hubbell, and J. L. Glenn	683
chapter 29	
<u>SCOUR OF FLAT SAND BEACHES DUE TO WAVE ACTION IN FRONT OF SEA WALLS</u>	
John B. Herbich, H. D. Murphy,' and B. Van Weele	705
PART 3. COASTAL ENGINEERING PROJECTS, DESIGN AND OPERATION	
chapter 30	
<u>DREDGING - PAST, PRESENT, AND FUTURE</u>	
Arthur L. McKnight	727
chapter 31	
<u>GROINS AND EFFECTS - MINIMIZING LIABILITIES</u>	
Omar J. Lillivang	749
chapter 32	
<u>USE OF LONG GROINS AS ARTIFICIAL HEADLANDS</u>	
James W. Dunham	755
chapter 33	
VARIATIONS IN GROIN DESIGN (<u>abstract only</u>)	
D. W. Berg and G. M. Watts	763
chapter 34	
<u>TRENDS IN SAND BY-PASSING SYSTEMS</u>	
George M. Watts	799
chapter 35	
<u>SAND BY-PASSING AT SANTA BARBARA HARBOR</u>	
William J. Herron, Jr.	805
chapter 36	
<u>PLANNING AND DESIGN OF A LOW-WEIR SECTION JETTY AT MASONBORO INLET, NORTH CAROLINA</u>	
Nels C. Magnuson	807

chapter 37	
<u>MODEL TESTS OF ENLARGED NAVIGATION CHANNEL AT MILLER SANDS BAR, COLUMBIA RIVER ESTUARY</u>	
Frank A. Herrmann, Jr.	821
chapter 38	
<u>UMPQUA JETTY SURVEILLANCE PROGRAM</u>	
Harold A. Kidby and Charles D. Price	845
chapter 39	
<u>RESTORING A SMALL BOAT BASIN DAMAGED BY THE 1964 ALASKA EARTHQUAKE</u>	
Norman L. Arno	861
chapter 40	
<u>DEVELOPMENT OF HURRICANE FLOOD PROTECTION FOR TEXAS CITY, TEXAS</u>	
Wayne M. Murphy and Charles W. Geelan	889
chapter 41	
ON THE OPTIMAL DESIGN OF RUBBLE MOUND HURRICANE BARRIERS (<u>abstract only</u>)	
R. T. McLaughlin	921
chapter 42	
<u>OPERATION OF HURRICANE BARRIERS IN NEW ENGLAND</u>	
Elliot F. Childs	923
chapter 43	
<u>OCEAN TEMPERATURE MEASUREMENTS FOR POWER PLANT DESIGN</u>	
W. O. Cheney and Gordon V. Richards	955
chapter 44	
<u>MARINE STUDIES FOR THE DESIGN AND CONSTRUCTION OF OFFSHORE PIPELINES</u>	
David R. Miller	

CHAPTER 3

COAST & GEODETIC SURVEY TSUNAMI PROPAGATION PROGRAM

Gaylord Miller
University of Hawaii
Honolulu, Hawaii

SYNOPSIS

Several programs for the computer solution of wave propagation in a two-dimensional velocity field have been devised in the last few years. These programs fit an analytic surface to points in the neighborhood of the wave ray which is being advanced. The ray curvature is then computed at the point in question using this local analytic surface. Difficulties with this technique are that the computed analytic surface changes abruptly from one grid square to the next, and that the surface-fitting technique is poorly adapted to data which are not on a rectangular grid. The method of computing the ray paths for the tsunami propagation program described here is based on a spatial convolution technique. Values and derivatives are determined from a numerical point of view basically, using spatial weighted averages. The weighting function is chosen for its wave number response (of ocean bottom roughness) in a way appropriate to any given tsunami frequency. There are no special discontinuities that occur as the ray progresses from one grid square to another. The computer technique in some way incorporates the "common sense" used when similar calculations are performed by hand.

CHAPTER 21

PREDICTOR EQUATIONS FOR BEACH PROCESSES & RESPONSES

Wyman Harrison
U. S. Coast and Geodetic Survey, Norfolk, Virginia

SYNOPSIS

Two variations of linear multiregression analysis of environmental variables in the beach-ocean-atmosphere system at Virginia Beach, Virginia are presented. The first variation is a least squares search procedure that is used to segregate out, from a large set of data, a small number of significant beach process elements (independent variables) that explain most of the variability in a given beach response element (dependent variable). The second variation of the analytical method employs a screening procedure that seeks specifically for the best predictor equation, where a beach response is taken as the predictand and several beach process elements are taken as predictors.

Results of the first analytical procedure show that if about 5 or 6 variables are segregated out of any group of about a dozen, these few account for essentially all of the variability explained by all twelve. Predictor equations obtained by the second analytical variation are tested against a set of independent data and, with one exception, are found to make reasonable predictions.

(Full article published in Journal of Geophysical Research, Vol. 70, No. 24, December 15, 1965, pages 6103-6109)

CHAPTER 35

SAND BY-PASSING AT SANTA BARBARA HARBOR

William J. Herron, Jr.
U. S. Army Engineer District
Los Angeles, California

SYNOPSIS

Santa Barbara has served coastal shipping since 1782. It was a well sheltered roadstead with a stable shoreline for 150 years when efforts were initiated to provide a secure harbor. One of the first known efforts was a harbor study made in 1922 by Colonel Leeds. In 1927-28 the existing breakwater was constructed and the result was severe erosion of the adjacent beaches.

The effects of the breakwater upon littoral sand movement has been the subject of intensive studies by Coastal Engineers and Oceanographers from 1930 to date. Three problems resulted from this interference with natural processes, accretion west of the harbor, erosion east of the harbor and creation of a trailing sandspit from the tip of the breakwater, that if allowed to grow would eventually close the harbor. A future erosion problem will result from reduction of sand supply due to urbanization of the area and construction of water conservation features.

Corrective measures have been periodic dredging of the sandspit and harbor area with deposition on the eroding beach from 1935 to 1952, and continuous dredging from 1956 to date by a small city owned dredge.

It is proposed to enlarge the harbor to provide complete enclosure and add an offshore breakwater to provide a sand trap, protection for a dredge, and protection of the harbor entrance.

Construction will probably start in 1967.

CHAPTER 41

ON THE OPTIMAL DESIGN OF RUBBLE-MOUND HURRICANE BARRIERS

Ronald T. McLaughlin
Massachusetts Institute of Technology
Cambridge, Massachusetts

SYNOPSIS

The optimal design of rubble-mound hurricane barriers is considered as a problem in maximizing an objective. On the basis of the function of a hurricane barrier and the effects of failure, a benefit function is constructed and its maximization outlined. The concept of a design wave is discussed in this context. The type of statistical data on waves and surges needed for such a function is defined and a feasible method for obtaining such data is laid out.

The actual design of the barrier is presented as a problem of sub-optimization or minimization of the cost for each level of protection. The decision variables and constraints are identified and the necessary data are outlined. As a by-product some significant gaps in existing research results are identified.

As many as possible of the concepts outlined above are demonstrated by means of a specific design study of a barrier for the East Passage of Narragansett Bay, Rhode Island. This study involved prediction of wave generation, estimation of refraction and design for a range of design waves. From the results it was possible to determine the general features of a minimum-cost design and recommend specific model studies for determining final design details.