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# Association of Island Marine Laboratories of the Caribbean

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# Book Reviews

**Quantification of Beach Profile Change,** by Magnus Larson, 1988. Printed by Grahn, Lund, Sweden. $US10.00. No ISBN.

The subject dealt with by the author has a great deal of interest, scientifically, technically and practically. The ultimate objective of the study was to develop an engineering numerical model of beach profile change which has the capability of simulating formation and movement of major morphologic features of the profile, such as bars and berms. Beach profile response produced by severe storm or hurricane events, with large erosion and possible dune retreat, was the principal target, although profile change occurring on longer time-scales, such as adjustment of beach fill, which involves accretionary processes as well as erosional, was also of interest. A basic assumption underlying this work is that major morphologic change occurring in and around the surf zone is produced by breaking and broken waves.

As a basis for model development, data sets from two large wave tank (LWT) experiments were used to understand the fundamental processes governing beach profile change and to establish cause and effect relationships between waves, water level, and properties, and beach profile response. Using data from LWT experiments, scaling effects were avoided, yet measurements were available for controlled conditions with the needed high resolution in space and time.

Data from two different LWT experiments were used in development of the numerical model; one experiment performed by the U.S. Army Corps of Engineers (CE) and the other experiment carried out by the Central Research Institute of Electric Power Industry (CRIEPI), Japan.

Efforts were concentrated on the presentation of non-dimensional parametric expressions for the actual recordings of profile changes in relation to materials and wave characteristics. No attempt was made to explore details of sediment dynamics. A number of good results were obtained particularly related to geometric properties of the profile that were quantified including bar volume, bar height, depth to bar crest, ratio of depth to bar trough and depth to bar crest, distance between break point and trough bottom, movement of mass center of bar, bar migration speed, bar slopes, active profile height, step and terrace slopes, berm volume, berm height, and berm slopes. This type of analysis stimulates similar analysis of field profiles and aids in setting standards for collecting field data.

Regression relationships were established between a number of geometric characteristics of the profile and wave and sand properties. In this process the dimensionless fall velocity ($H_0$/wT) emerged as an important parameter together with the deepwater wave steepness ($H_0/L_0$). Quantities that could be related to $H_0$/wT, $H_0/L_0$, or both were bar volume, ratio of trough depth to crest depth, bar height, and active profile height, all normalized with different wave or sand properties.

It was found that the criterion to distinguish between bar and berm profiles were closely related to the predominant direction of cross-shore transports. A bar formed under mainly offshore-directed transport and a berm formed under mainly onshore-directed transport. The validity of the equilibrium beach profile concept was confirmed by the LWT experiments, which clearly showed a systematic decrease in profile change as time elapsed.

By comparing the initial and final profile surveys, an "equilibrium transport distribution" was defined and calculated, which indicated how sand was redistributed along the profile to achieve an equilibrium configuration. Equilibrium distribution could be classified into three characteristic shapes in a majority of the experimental cases, called Erosional (Type E), Accretionary (Type A), and mixed Accretionary-Erosional (Type AE). Type E-distributions showed transport directed offshore along the entire profile, whereas Type A-distributions showed transport directed onshore along the entire profile. Type AE-distributions were characterized by a mixed response with offshore transport along the shoreward portion of the profile and onshore transport along the seaward portion of the profile.

The profiles were divided into four different zones regarding transport rate properties, in analogy with recent findings from nearshore wave dynamics and characteristics of the transport rate distribution. These zones were: prebreaking zone (I), breaker transition zone (II), broken wave zone (III), and swash zone (IV). For Zone I, the LWT experiments showed that the transport rate was well approximated by an exponential decay with distance from the break point, with a spatial decay coefficient proportional to D/H for erosional conditions and having an average value of 0.18 m. The exponential decay proved to be valid for onshore transport as well, but the spatial decay coefficient was almost constant, with an average value of 0.11. For Zone II, which extends over the narrow range from break point to plunge point, it was difficult to extract information on the transport characteristics from the LWT experiments. Zone III encompasses the main part of the surf zone, and the transport rate was demonstrated to be closely related to the energy dissipation per unit volume. In Zone IV, the region dominated by runup and backrush, the transport rate is governed by swash dynamics.

A numerical model was developed on the basis of quantitative analysis of the LWT wave and profile change data. The model calculates the wave height distribution across-shore at each time step with linear wave theory up to the break point, and thereafter with a breaker decay model in the surf zone. The break point is determined from an empirical criterion, derived from the CRIEPI data set, relating the breaker ratio to surf similarity parameter in terms of the local slope seaward of the break point and $H_0/L_0$. A non-linear shoaling theory was applied initially but it overestimated the breaking wave height and did not produce as good agreement as linear wave theory in comparisons with the LWT data. In the model, the transport rate distribution was determined by using local wave properties along the profile. The profile is divided into four different zones according to findings from the LWT data sets, and the respective transport relationships were used to determine the transport magnitude.

A likely point of discussion is the selection of some boundary assumptions. The $y^{3/2} = px$ profile description is used all over with reference to an assumption of the same energy loss per volume through the surf zone. The Vellinga/Bruun (J.C.R., Vol. 3, No. 2) $y^{5/4} = px$ profile is well demonstrated by field and laboratory results in the nearshore surf zone while $y^{3/2} = px$ should only be used outside the breaker zone (Brunn, 1954, as cited). The combination of these two profiles is better than the use of $y^{3/2} = px$ all over based on an unrealistic assumption outside the surf zone.

Eq. (22) has an assumption in the existence of an equilibrium geometrical profile characterized by no excess energy dissipation and by no cross-shore sand transport. Vellinga's (1986) research showed that the amount of suspension load is proportional to $dE(x)/dx$. If this assumption is used together with an assumption of equal bottom shear stress (Brunn, *Journal of Coastal Research*, Vol. 3, No. 2, 1988), one arrives at $y^{3/2} = px$ valid up to a certain depth where this assumption on equal sheer stress related to bottom geometries (ripple marks) no longer are a realistic philosophy. Here profile development and geometries are rather determined by diffusion and 3-dimensional offshore drifts. The limited depth may be defined as 3.5Hb 50-100 yrs (Birkemeyer, 1985).

In his tests and analyses, the author operated with one characteristic grain size realizing that nature is not all that simple. His Fig. 76 shows the distribution of grain sizes over a profile recorded at Duke, North Carolina. Some qualitative agreements with the author's model results were still possible. Using the maximum (peak of distribution) grain size as indicted, the reviewer found good agreement with the author's Fig. 76 and the $d^{5/12} \cdot D^{3/4}$ rule (Bruun, *Journal of Coastal Research*, Vol. 3, No. 2, 1988).

Realizing that median grain size varied across the beach profile with a noticeably larger grain size on the foreshore the author made an attempt to represent such variation in the numerical model by using two different grain sizes along the profile. A larger grain size (2.0 mm) was employed on the foreshore to a distance approximately 130 m from the base line, whereas a finer grain size (0.15 mm) was used from this point and seaward. The larger grain size implied a larger equilibrium energy dissipation with correspondingly more wave energy needed to move material. Furthermore, the equilibrium energy dissipation as given by Moore (1982) was reduced according to the 0.75-factor determined from the LWT experiments. Additional variation in median grain size across-shore somewhat improved the fit of the model in trial simulations, but was considered to be unrealistic because of the added complexity and because the movement and mixing of individual grains was not simulated in the model.

The author also draws some practical conclusions regarding "profile nourishment" as opposed to "beach nourishment." Profile nourishment in its latest definition, however, is to be understood as nourishment of the entire profile extending from the upper part of the beach down to a certain depth determined by profile geometries and practical considerations. The drawback with beach nourishment only is the rapid loss of material offshore as well as longshore due to the steep nourishment deposit slope. If nourishment of the offshore is undertaken carefully so that the new profile approaches the natural profile geometry losses will hardly increase as postulated apart from an initial period of adjustment of the rough profile to a smooth profile. The author's suggestion of nourishment of the entire profile still is correct in theory as well as practice.

Figures, tables, and illustrations are clear. The list of reference literature is comprehensive, but somewhat "Americanized." Some European works of earlier date are not observed.

The book provides good indications of future research on basic aspects may be concentrated to best advantage. It serves the useful purpose of pointing out the essential parameters in profile development.

The author's conclusive statement that "The developed numerical model successfully reproduced beach profile change both in large tanks and in the field. The approach of focusing on macro-scale profile features such as bars and berms proved highly productive, both for providing more thorough and quantitative understanding of beach profile change to wave action and for promoting development of numerical models for simulating coastal processes aimed at engineering use.", is endorsed.

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**Cape Cod Field Trips,** by Stephen Leatherman, 1988. Coastal Publication Series, Laboratory for Coastal Research, University of Maryland, College Park, MD 20742, USA. 132p. No ISBN. $6.00 (plus $1.00 handling).

Steve Leatherman has stepped bravely into the shoes of Henry Thoreau, John Wilson, Barbara Chamberlain and Arthur Strahler and has written a book about Cape Cod. One can only speculate as to what cerebral and even mythical processes have operated to draw these geologists, like moths to a flame, to proselytize and extol on the natural wonders and beauty of 'America's beckoning finger.'

Steve Leatherman is well-qualified to produce this volume as he has published a number of papers about the Cape, especially on its ever-changing coastline. The forerunner of this book was the Author's "Environmental Geologic Guide" published some ten years ago. However there is a difference. While the original volume was aimed at the professional, this one is aimed unashamedly at the amateur. Its low cost format suggests this book is clearly designed to be sold with sun hats, ice creams and postcards, rather than through specialist academic book stores. With the Cape attracting around 3 million visitors a year the prospects for a good sale are high.

The book comprises two sections. The first 33 pages gives a brief, but wide ranging introduction to glacial and coastal processes (including sea-level rise and coastal ecology), plus a few lines on 'human development'. Despite the limited space, the text conveys many thoughtful and crucial points. The second section (80 pages) forms the Guide itself, providing landform intrepretation for 27 sites from the Cape Cod canal to Provincetown. These interpretations are augmented by historical anecdotes, details of memorable storms and descriptions of now-vanished railroads, quarries, roadways and buildings. Everything is profusely illustrated by cartoons, photographs and sketches, sixty five in all.

It would be unfair to be too critical of this volume, as it is clearly designed to attract and hold the attention of non-geologists. In this sense I think the book succeeds admirably. Some of the explanations of landforms are a little glib and superficial, and the figures are somewhat stylised. The mix of Imperial and SI units is unfortunate. Personally I don't like the black and blue printing, it makes the photographs (all in shades of blue) look old-fashioned. But overall this is a nicely produced volume. I wish more of us took the time to explain our ideas so lucidly to the general public.

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**Tides, Surges and Mean Sea-level,** by David Pugh, 1987. Wiley, New York. 472p. $110.00. ISBN 0-471-91505-X

Our knowledge of tides and particular tidal prediction has come a long way since the late 18th century when models of tidal prediction were a closely guarded family secret in England. In today's more cooperative scientific community we can all benefit from the knowledge of tidal specialists such as David Pugh, particularly with the publication of this excellent text. This book is subtitled 'a handbook for engineers and scientists.' It is aimed at the vast majority of those who deal with the coast specifically hydrographers, engineers, geologists and biologists, who while not tidal specialists require an understanding and working knowledge of tides and perhaps surges and mean sea-level.

The book contains eleven chapters. Following the Introduction, tides are treated in the following four chapters. Chapter 2 "Observation and Data Reduction" covers instruments from tide poles to satellite altimetry and drouges to remote sensing. Chapter 3 covers "Forces," while chapter 4 "Analysis and Prediction" presents a clear and lucid account of all 35 har-