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The Influence of Infiltration and Exfiltration Processes on Maximum Wave Run-Up: A Field Study on Trinidad Beaches

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Abstract : Wave run-up may be defined as the time-varying position of the landward extent of the water's edge, measured vertically from the mean water level position. The hydrodynamics of the swash zone and the accurate prediction of maximum wave run-up, play a critical role in the study of coastal engineering. The understanding of these processes is necessary for the modeling of sediment transport, beach recovery and the design and maintenance of coastal engineering structures. However, due to the complex nature of the swash zone, there remains a lack of detailed knowledge in this area. Particularly, there has been found to be insufficient consideration of bed porosity and ultimately infiltration/exfiltration processes, in the development of wave run-up models. Theoretically, there should be an inverse relationship between maximum wave run-up and beach porosity. The greater the rate of infiltration during an event, associated with a larger bed porosity, the lower the magnitude of the maximum wave run-up. Additionally, most models have been developed using data collected on North American or Australian beaches and may have limitations when used for operational forecasting in Trinidad. This paper aims to assess the influence and significance of infiltration and exfiltration processes on wave run-up magnitudes within the swash zone. It also seeks to pay particular attention to how well various empirical formulae can predict maximum run-up on contrasting beaches in Trinidad. Traditional surveying techniques will be used to collect wave run-up and cross-sectional data on various beaches. Wave data from wave gauges and wave models will be used as well as porosity measurements collected using a double ring infiltrometer. The relationship between maximum wave run-up and differing physical parameters will be investigated using correlation analyses. These physical parameters comprise wave and beach characteristics such as wave height, wave direction, period, beach slope, the magnitude of wave setup, and beach porosity. Most parameterizations to determine the maximum wave run-up are described using differing parameters and do not always have a good predictive capability. This study seeks to improve the formulation of wave run-up by using the aforementioned parameters to generate a formulation with a special focus on the influence of infiltration/exfiltration processes. This will further contribute to the improvement of the prediction of sediment transport, beach recovery and design of coastal engineering structures in Trinidad.

Keywords : beach porosity, empirical models, infiltration, swash, wave run-up
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