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Sensitive Analysis on Effective Parameters in Breakwater Design against Wave Diffraction

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ABSTRACT

Beaches erode and the obvious environmental and landscape degradation of many coastal stretches are problems that coastal engineers are spending time solving. Different protection methods have been used over time, most on the basis of the artificial nourishment of beaches and the building structures such as groynes and detached breakwaters. Breakwaters are artificial structures, generally parallel to the coastline, inspired by the working of natural formations, protecting a certain stretch from wave action and being able to create accretion areas. This is why these structures have been in general use, with different results, since the 1970s in countries such as Japan, the United States, Spain, Italy, and Australia. Lakes coast confronts a wide range of natural hazards from severe storms, floods, landslides and shoreline erosion. All of these coastal hazards threaten both lives and property-a problem that becomes more pressing as the coastal population continues to rise. Coastal erosion, deposition, and flooding can also be exacerbated by lake level regulation, water diversion and coastal resource use.

Structures like breakwaters always confront sea phenomenon like diffraction and refraction of waves. Diffraction, which be made by contact of water waves to breakwater structure and results almost concentric circles of waves, makes evaluating this phenomenon far more important on structures. By using the powerful software MIKE 21 in sea hydraulics problems, finding the optimized model of the breakwater arms can be obtained.

Meanwhile other factors are playing role in this optimized model. By sensitive analysis of the main parameters such as entrance wave spectrum, wave period, porosity coefficient of breakwater and effect of spongy layers on the results, the partnership and affection of all parameters on the result of the model will be revealed. Presenting the optimized breakwater models against diffraction and Showing the most important parameters on the basis of sensitive analysis is the results of this research.

1. INTRODUCTION

Diffraction refers to various phenomena which occur when a wave encounters an obstacle. It is described as the apparent bending of waves around small obstacles and the spreading out of waves past small openings. While diffraction occurs whenever propagating waves encounter such changes, its effects are generally most pronounced for waves where the wavelength is on the order of the size of the diffracting objects. If the obstructing object provides multiple, closely-spaced openings, a complex pattern of varying intensity can result. This is due to the superposition, or interference, of different parts of a wave that traveled to the observer by different paths.

Diffraction arises because of the way in which waves propagate; this is described by the Huygens–Fresnel principle. The propagation of a wave can be visualized by considering every point on a wave front as a point source for a secondary radial wave. The subsequent propagation and addition of all these radial waves form the new wave front. When waves are added together, their sum is determined by the relative phases as well as the amplitudes of the individual waves, an effect which is often known as wave interference. The summed amplitude of the waves can have any value between zero and the sum of the individual amplitudes. Hence, diffraction patterns usually have a series of maxima and minima.

The form of a diffraction pattern can be determined from the sum of the phases and amplitudes of the Huygens wavelets at each point in space. There are various analytical models which can be used to do this