

# A PRELIMINARY EXPERIMENT OF NEARSHORE CURRENTS GENERATED DUE TO TRANSVERSE PHASE DIFFERENCES

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## INTRODUCTION

The vorticity generation due to the ends of wave crests and its resultant rip current have been studied (Johnson and Pattiaratchi, 2006; Clark et al., 2012; Choi et al., 2015; Peregrine, 1998; Postacchini et al., 2014). Recently, a laboratory experiment was conducted to observe rip currents formed between the ends of breaking wave crests (Choi and Roh, 2020) by using the wave generation method of pseudo intersecting wave trains. In this method, regular waves were generated by running two parts of wave maker out of phase. Their pseudo intersecting wave trains was compared with the intersecting wave trains generated by regular waves having the same wave period and the slightly different two wave directions. However, the pseudo intersecting wave trains, i.e., out-of-phase wave trains, could be formed in the field by the transformation of long-crest waves propagating over a specific change of topography in an intermediate water depth, for example, a submerged semi-infinite straight seamount range parallel to the shoreline. The long-crest wave train can be divided into two wave trains with phase difference because of the different wave speeds over the end of the submerged structure.

To understand the evolution process of nearshore currents generated due to transverse phase differences, a laboratory experiment was planned. This study showed the preliminary laboratory experiments in which two wave trains with phase differences and its resultant nearshore currents were observed using the optical flow method.

## METHOD

The laboratory experiment was conducted in the wave basin in 40m(L)x30m(W)x1.2m(H) with the transversely constant bathymetry which has the equilibrium beach slope according to an empirical function (Dean, 1991). To produce the successive ends of the wave crests, two groups of wave-maker piston panels were operated with out-of-phase in the transverse direction. In order to observe the rip current developing along the transient area of two wave trains, approximately two thousand particles (i.e., holed plastic balls) were released at the shoreline after wave generation and the video cameras, installed on the ceiling of the laboratory (8m high from the basin bottom), were utilized to record the motion of the particles. In the experiment using the wave generation with 180 and 120-degree transverse phase differences, the evolutions of nearshore currents were observed.

## RESULT

The snapshot images of the video camera on the laboratory ceiling in Figure 1 showed particles moving to offshore which present the evolution of nearshore currents including rip currents caused by the vortex generation mechanism and the gradient of the wave-induced momentum flux. Figure 1(a) shows the case presenting two wave trains with 180-degree transverse phase difference (i.e., out of phase), and Figure 1(b) shows the case with 120-degree transverse phase difference at 120 seconds after the first wave arriving at

the shore.

As a result, it was confirmed that the rip currents were developed through the transient area of two wave trains with transverse phase difference as the node area of the intersecting wave trains. From the present preliminary experiment, it was inferred that the transient area of two wave trains in the 120-degree case was off the node line of the 180-degree case, as well as was not as clear as that of the 180-degree case. Since the transient node area was not clear, the rip current was relatively weak because of the opposing wave-current interaction.

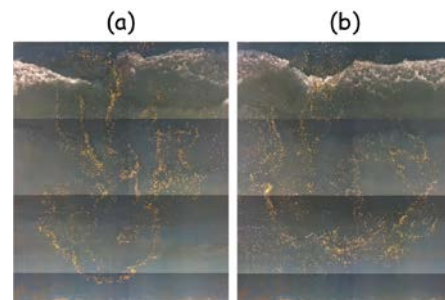


Figure 1 - Snapshot of the experiment ( $H=15\text{cm}$ ,  $T=2.4\text{s}$ ) ( $t=120\text{s}$ ) presenting particles moving to offshore due to transverse phase differences of (a) 180 degree (b) 120 degree

## DISCUSSION

In the future study, the characteristics of rip currents due to transverse phase difference will be observed in more experiments with various phase differences by using the optical flow method (LSPIV, Large Scale Particle Image Velocimeter) and particle tracking method.

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