EVOLUTION OF NEARSHORE CURRENTS AROUND SUBMERGED BREAKWATERS

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INTRODUCTION

Laboratory and numerical experiments were carried out to simulate waves and currents around three submerged breakwater (hereafter SB) system on fixed bed condition. Assuming that a large current circulation converging behind the structure will enhance the sediment entrapment, scales of circulations were analyzed using PTV (particle tracking velocimetry) technique and numerical experiments. Optimum ranges of wave and structural dimensions are proposed here for effective development of circulation currents behind SB for shore protection based on this concept.

EXPERIMAENTAL METHODS

Laboratory Experiments

All the experiments were conducted in an 11mx6.5mx0.25m wave basin using normal incident regular waves. A video camera was mounted over the flow field behind the SB system to record the trajectory of plastic tracer particles (for PTV). The parameters X_c, Y_c, X_f, Y_f (which are explained in Figure 1) were determined by tracing the streamlines of the current field.

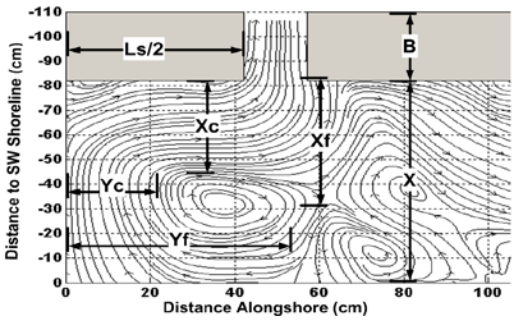

Figure 1 – Dimensional parameters X_c Y_c X_f Y_f based on laboratory experiments (streamline plot of current field)

Numerical Experiments

A 2DH numerical model has been developed based on Boussinesq equations (Nwogu, 1993). The rate of energy dissipation due to wave breaking considered to be governed by the magnitude of the eddy viscosity, which is related to turbulent kinetic energy and mixing length (Nwogu, 1996).

RESULTS & DISCUSSION

A pair of circulation currents was observed behind SB in certain experiments and this pair of circulation currents is expected to enhance sediment entrapment. Based on this concept, it was attempted to investigate the optimum wave and structural parameters for effective development of these circulation currents. However, as the geometry of circulation observed is not exactly a circle or an ellipse, four new parameters are introduced here (see Figure 1) for the analysis and they are non-dimensionalized as follows;

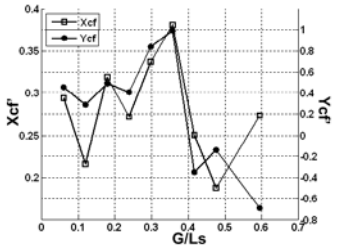

Figure 2 – Dimensionless scale of circulation vs. (G/L_s) for the case, Hi = 0.042 m, T = 1.25 s, X = 0.85 m, $R(freebaord)$ = 0.01 m, B = 0.3 m

The relationship between non-dimensional gap width, (G/L_s) and non-dimensional scale of circulation is shown in Figure 2.

CONCLUSIONS

A series of laboratory experiments were carried out to investigate the optimum scale of circulation behind three SB system under normal incident regular waves. Initial results from physical model tests showed consistency of the development of circulation currents behind the SB system and the scale of circulation.

REFERENCES

Madsen , P.A., Sorensen, O.R., Schaffer, H.A., (1997a). Surf zone dynamics simulated by a Boussinesq type model. Part I. Model description and cross-shore motion of regular waves. Coastal Engineering 32, 255-287.