STUDY ON ESTIMATON OF SCOURING BEHIND THE BREAKWATER

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INTRODUCTION

For realization of tenacious structure, it is significant to investigate the influence of scouring behind the seawall due to tsunami overflow. Although studies have been made on the estimation of maximum scour depth, there is few studies on the relationship between overflow time and scour depth.

TOPIC OF INQUIRY

The purpose of this study is to design the estimation formula of scour depth. First, the experiments were conducted to verify phenomenon of scour. Figure 1 shows the cross section of the experiment**.** Tohoku Keisa No. 6 sand (D_{50} = 0.34 mm) was used for the sand ground (2.0 m long, 0.3 m wide, and 0.4 m height), and we used pumps to circulate in the flume to simulate long time overflow.
Second, the result of the past experiments conducted by Arikawa et al. (2014) were reviewed. Figure 2 shows the relationships between the vortex diameter R indicated by Noguchi et al. (1997) and the observed scour depth. Moreover, we defined the non-dimensional time and the non-dimensional scour depth, and examined the temporal change of the scour depth. As a result, it was found that the observed value roughly agree with the Weibull cumulative distribution function.
Finally, we examined the Hachinohe port breakwater which was damaged by the Great East Japan Earthquake.

CONCLUSION

This study clarified the phenomenon of scour behind the breakwater. Main conclusion are shown as below.
We attempted to design the estimation equation of scour depth, and the equation we designed is shown as below.

$$D_n(t) = 1 - e^{-\sqrt{t_n}}$$

This equation is the Weibull cumulative distribution function. In this equation, the D_n means the non-dimensional scour depth and the t_n means the non-dimensional time. The D_n and the t_n are defined as below.

$$D_n = \frac{D(t)}{5.83R}$$

$$t_n = \frac{u_*}{\gamma_a R} t$$

$$R = g^{-\frac{1}{4}} q^{\frac{1}{2}} Z_f^{\frac{1}{4}}$$

$$u_* = \sqrt{8.41 \times (d)^{11/32}}\ [cm/s]$$

$D(t)$ is the scour depth, R is the vortex diameter indicated by Noguchi et al.(1997), g is the gravitational acceleration, q is the overflow rate and Zf is the overflow height. u_* is the critical friction velocity indicated by Iwagaki's formula, d is the particle diameter$[cm/s]$. γ_a is the experimental constant (=20). Figure 3 shows the comparison between Weibull function and observed value. It was confirmed that the estimation equation is comparable with the observed value relatively.

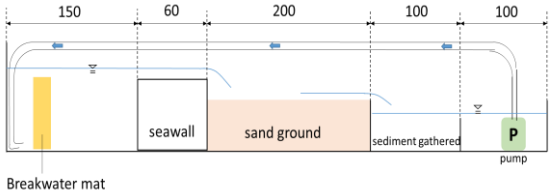

Figure 1- Cross section of scour experiment (unit : cm)

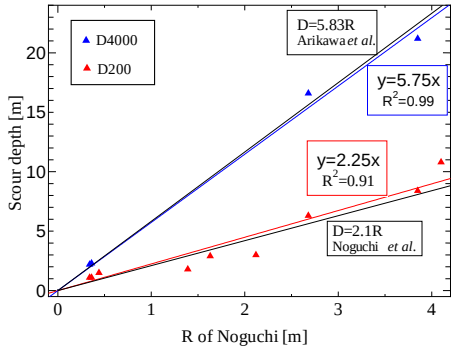

Figure 2- Relationship between R and the scour depth

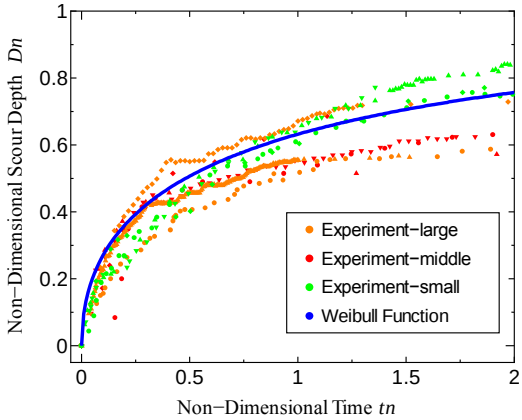

Figure 3 - Comparison between Weibull function and observed value

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