

## **Study on a Wave Force Acting on a Filter Unit on Sloping Breakwater and Its Stability**

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### **ABSTRACT**

Stability of a Filter Unit (FU) on uniform slope of rubble mound breakwater is investigated based on model experiments in which the stability, wave force and pore pressures are measured. Numerical simulation also computes the pore pressure of sloping breakwater. The uplift force due to difference of pore pressures on upper and lower surfaces of an FU is found to act on the FU installed near the shoreline and it affects stability significantly. Numerical analysis reproduces well the features of pore pressure in the FU layer. It is also revealed that the Hudson coefficient of FU is larger than that of armor rubble, which indicates that an FU is suitable in practical use as far as stability is concerned.

**KEY WORDS:** filter unit; pore pressure; stability; uplift force; rubble mound breakwater; Hudson formula.

### **INTRODUCTION**

Stability of armor rubbles and blocks has been investigated by many researchers. Hudson formula (Hudson, 1959) which gives stable weight and stability formula proposed by van der Meer (1987) which expresses the stability in terms of the nominal diameter have been widely used in the estimation of stability of armor units of a rubble mound breakwater. For a structure under severe wave condition, huge size of armor units may be required. In Japan and some other countries, it is difficult to obtain such large natural stones, and therefore concrete blocks are commonly used as armor units of breakwaters under severe wave condition. Recently, the new armor unit which consists of mesh bag and stones (called as Filter Unit, see Fig.-1) is proposed. Originally, filter units have been used to protect foot of river dike and protection work against river bed erosion. However, filter units are expected to be used in coastal engineering field (Deguchi, 2002) and

armor units may be one application. To use filter units for this purpose, there are two major concerns. One is the durability of a mesh bag and the other is the stability of a filter unit against waves. In this study, discussions are focused on the stability of a filter unit. Regarding the stability, some investigations have been done. Kubota et al. (2002, 2003) conducted hydraulic model tests to investigate their stability used as armor units of a rubble mound of a composite breakwater and obtained their stability number. However, stability of filter units used for armor units of rubble mound breakwater (sloping breakwater) has not been investigated yet.

In this study, model experiments have been conducted using filter units



(a) plane view



(b) side view

Fig.-1 Model of filter unit