
# Performance of gabion revetments for stabilizing beach profile


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## Introduction

Beach erosion due to wave action

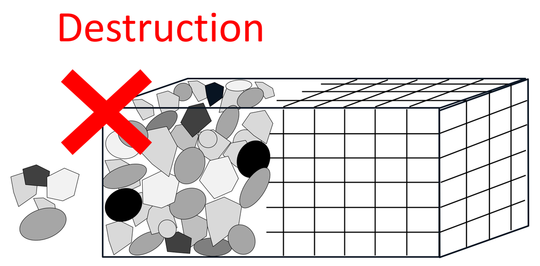

Coasts along the sea of Okhotsk, Japan

■ Gabion revetment

- ✓ Dissipating wave energy
- ✓ Protecting eroded beach until its natural recovery to an equilibrium beach profile

Kanagawa, Japan (Towaron Co.)

◆ Rectangular gabion

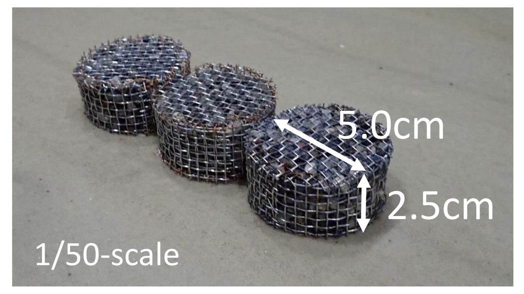



✓ Displacement of the rockfills

Deformation /destruction of the basket

Short lifetime of the revetment

◆ Round-shaped gabion 'Daruma-Kago'




Round gabion models used in this study

✓ Efficiently packed rockfills

Possibly achieve longer lifetime than the rectangular ones

✓ High flexibility of the arrangement

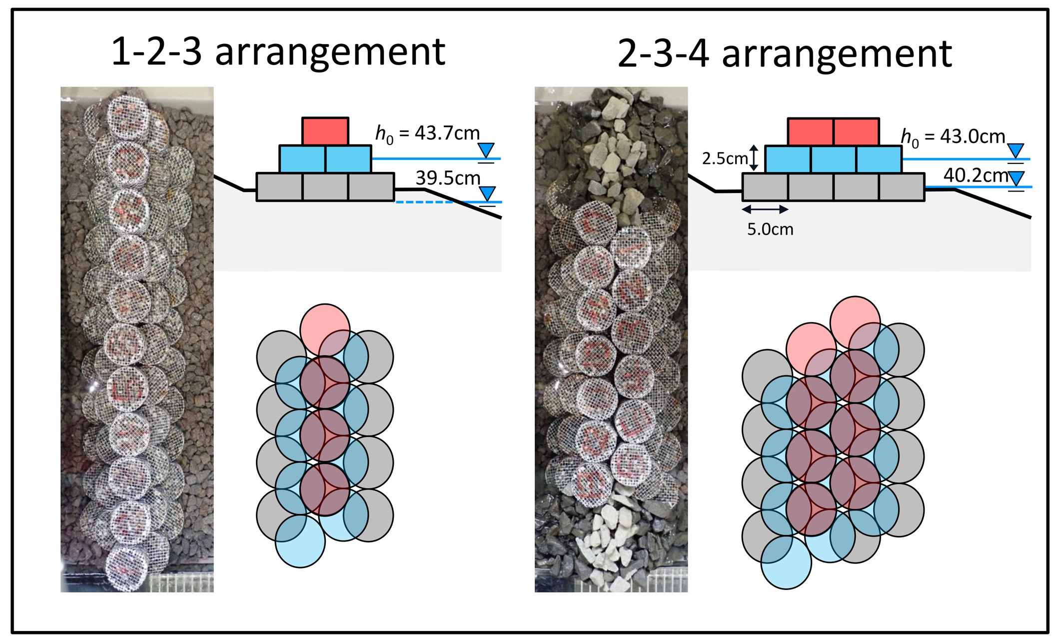
### ◆ Objective

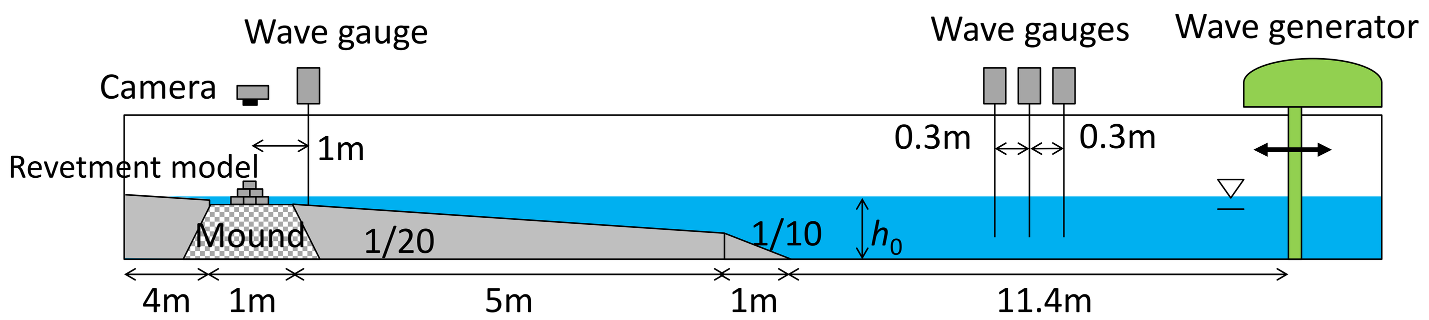
To assess the characteristics of the round-gabion revetment by performing two kinds of laboratory experiments:

- Stabilization of the round-gabion revetment
- Stabilization of the beach profile

## Stability of the round-gabion revetment

### ◆ Experimental setup




| | Model scale (1/50) | Real scale |
|---|---|---|
| Significant wave height $H_S$ | 2.8 - 11.2 cm | 1.4 - 5.6 m |
| Significant wave period $T_S$ | 1.5 - 4.8 s | 10.6 - 33.9 s |
| Wave type | Irregular waves (Modified B-M spectrum) | |
| Number of the generated waves | 800 - 1800 | |
| Initial water level $h_0$ | Bottom of the 1st layer-Middle of the 2ndlayer Varied from 40.0 cm - 43.7 cm | |

Assuming the rise in the sea level due to high tide and storm surge

### ◆ Results

Safety number: $N_S$, $K_d$ value

$$N_0 = \frac{Daruma\text{−}kago\ that\ moved\ more\ than\ radius\ from\ the\ initial}{Total\ of\ Daruma\text{−}kago}$$

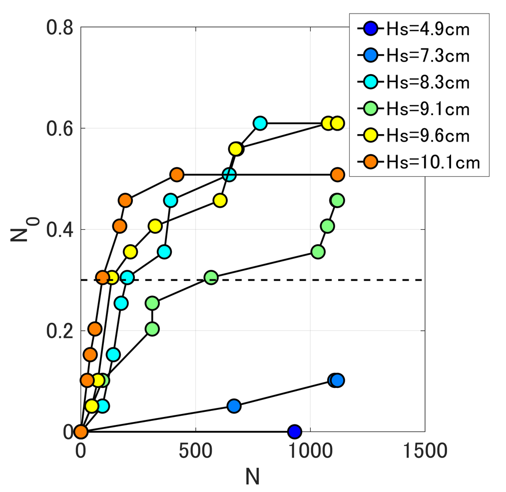
$$N_0 = c\sqrt{N} \Rightarrow c = N_0/N^{0.5}$$

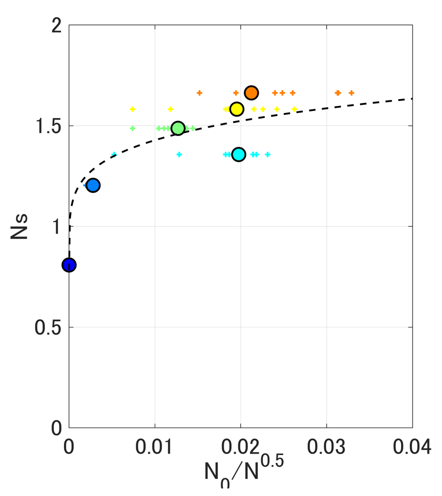
$$N_S' = H_S/(S_r - 1)(W_r/\rho_r)^{1/3}$$

Takahashi et al. (1998)

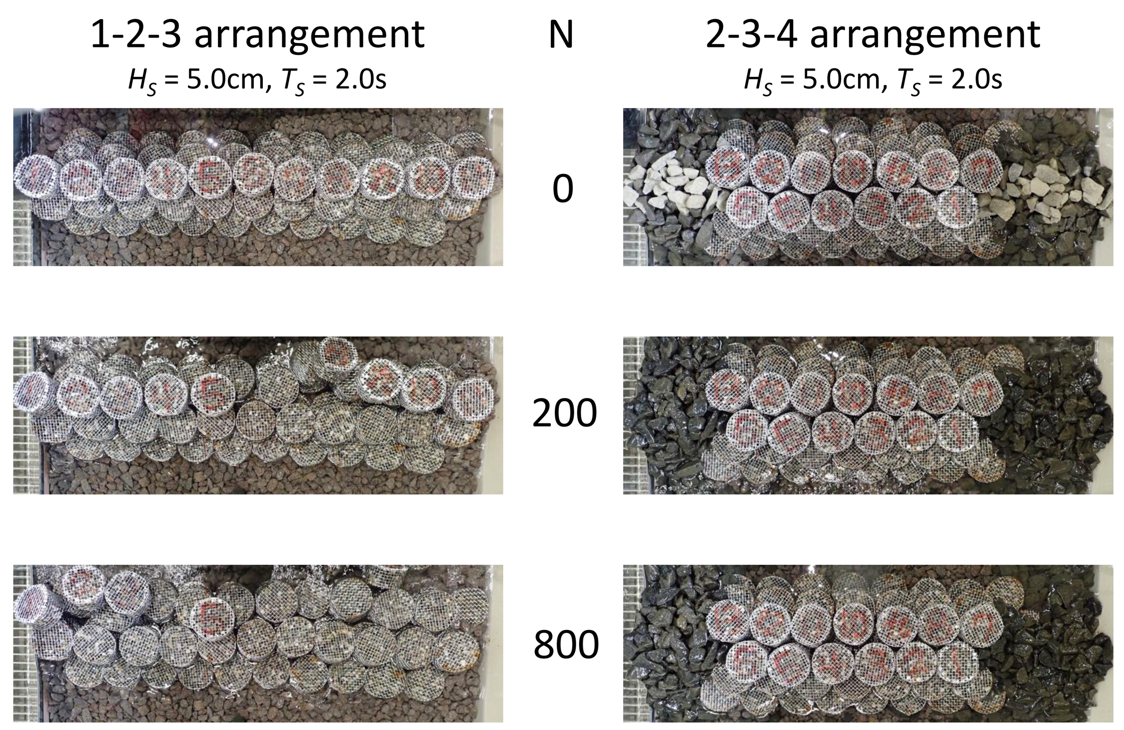
$$\begin{cases} N_S = C_H[a(N_0/N^{0.5})^{0.2}+b] \\ C_H = \dfrac{1.4}{H_{1/20}H_S} \end{cases}$$

$N_0$ : Damage level
$N$ : Number of the waves
$H_S$ : Significant wave height
$S_r$ : Specific gravity of gabions
$W_r$ : Weight of gabions
$\rho_r$ : Density of gabions
$N_S$ : Safety number
$a$, $b$ : Coefficient
$C_H$ : Coefficient representing breaking
$H_{1/20}$ : Highest 5% wave height




The typical photos recorded from the top of the wave tank

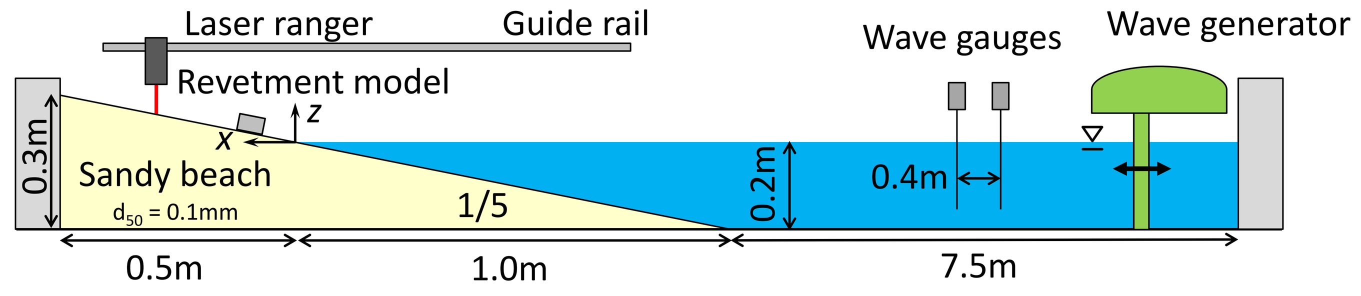


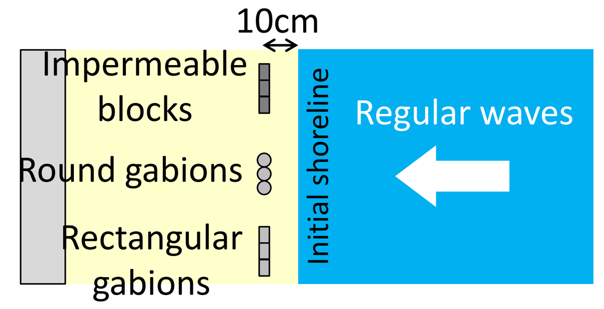

| $h_0$ | 1-2-3 arrangement | 2-3-4 arrangement |
|---|---|---|
| Mid. of 2nd | 0.7 (0.3) | 1.7-2.0 (4.9-8.1) |
| Mid. 1/4 of 2nd | 1.0 (1.0) | — |
| Bot. of 2nd | 1.4 (2.9) | $N_0$ < 0.3 |
| Mid. of 1st | 1.5-1.8 (3.6-5.9) | $N_0$ < 0.3 |
| Bot. of 1st | $N_0$ < 0.3 | — |

The sufficient performance of the gabion revetment can be achieved by optimizing the arrangement of the gabions by considering the various condition at the construction site

## Beach profile around the gabions

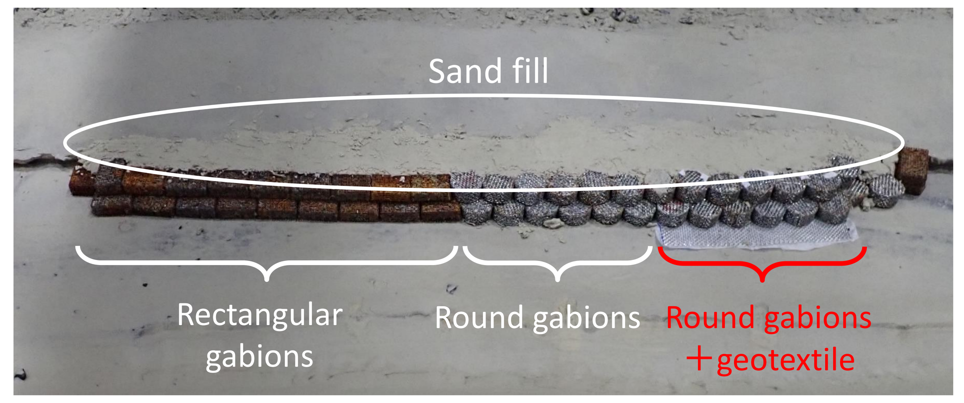
### ◆ Experimental setup

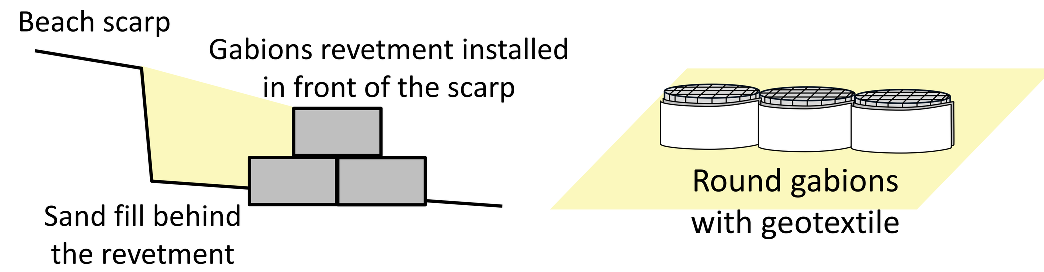


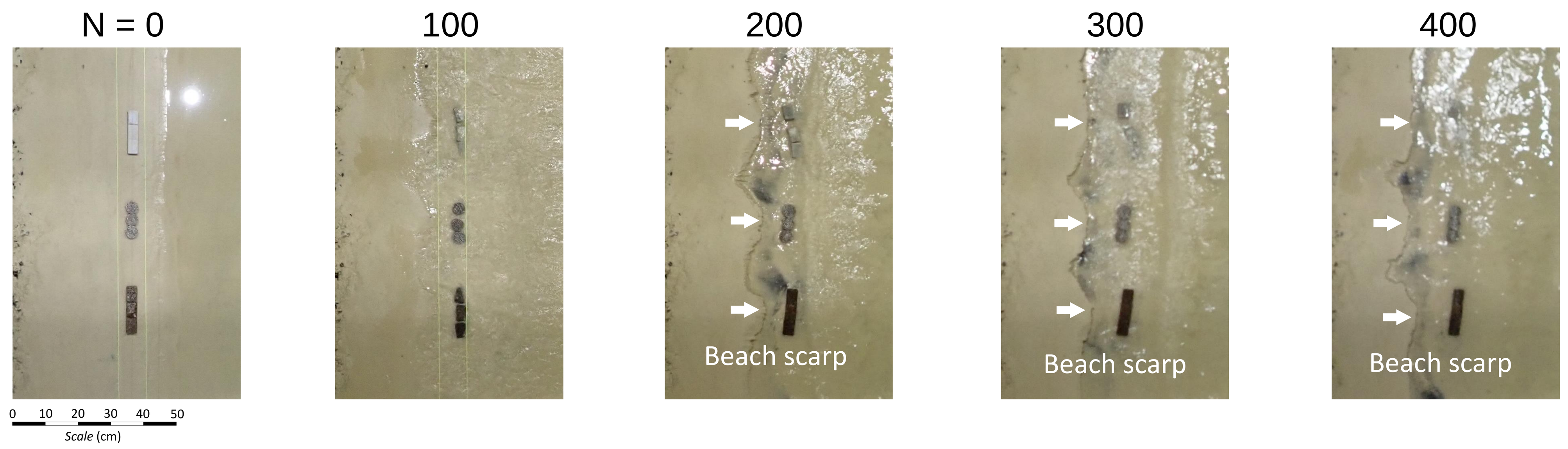

| | Model scale (1/50) | Real scale |
|---|---|---|
| Wave height $H$ | 4.0 cm | 2.0 m |
| Wave period $T$ | 1.0 s | 7.1 s |
| Wave type | Regular waves | |
| Number of the generated waves | ～1000 | |

*Application* : Add geotextile

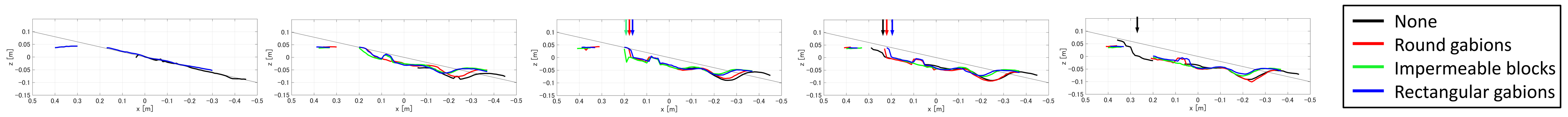


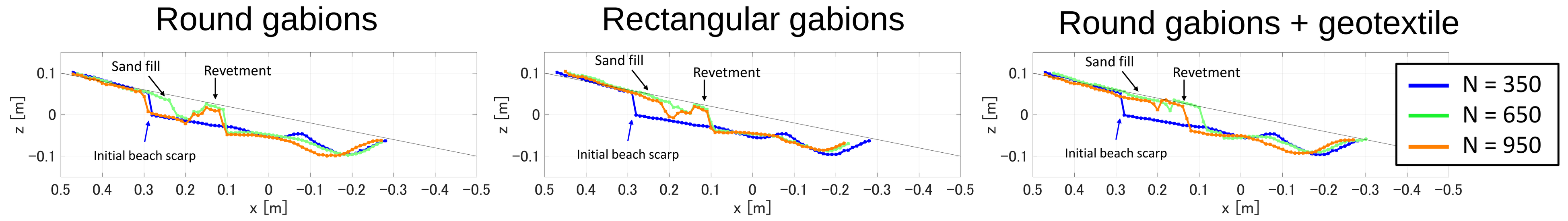

### ◆ Results




Round and rectangular gabions slowed down the development of the beach scarp




- Results of application case




## Conclusions

- ➢ In this study, we evaluated the wave stability of the round-gabion revetment and the performance as a countermeasure against beach scarp retreat through two kinds of laboratory experiments.
- ➢ When there is no significant water level rises, the revetment exhibits high stability. Although the stability of the revetment decreases as the water level rises, it was clarified that increasing the arrangement of gabions can increase the stability.
- ➢ The round-gabion revetments have the effect of suppressing the formation of the beach scarp. The sand retention function can be improved by using geotextile together.