Experiments of Automatic Reinforced Lumber Tsunami Mitigation Facilities

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Key words : Anti-Tsunami Door, movable breakwater, wooden structure, unit structure, Level 2 tsunami

General

Hamada invented tsunami hazard reduction facility which adopts door shaped lumber structure, is functioned automatically by its buoyancy when tsunami attack and mainly prevents the main parts of tsunami which follows the first attack of tsunami. Its name Anti-Tsunami Door (ATD). ATD has unit structure (practical sizes are approx. 3m height, 5m width and 20cm thickness) which can be installed sequentially along with coast line, so that it can be applied to reduce tsunami hazard of long coast line. And ATD's structure could be arranged like multiple folding screen so that e.g. 5 times folding of 3 m height ATD might correspond with 15m height tsunami while the installed height during normal time will be only 100cm (20cm thickness x 5 = 100cm). This will help to keep the sight of residence during normal time and acknowledge the attacking tsunami at emergency. ATD uses wood as main material which is naturally reproduced, so it is environmental friendly and economical. If it is confirmed that ATD has realistic tsunami reduction effect, it is expected that ATD will be applied as economical facility for Level 2 tsunami. And also ATD requires simple foundation and support, so that it is expected that it would be constructed on the existing concrete-made breakwater and improves its corresponding tsunami height.

1. Experiment General

(1) Place : Kyoto University, Disaster Prevention Research institute, Ujigawa Open Laboratory,

(2) Facilities : Multi-purpose wave-making watercourse (Width:1m、Depth:1.5m, Length:50m)

Figure 1 : Experiment Facilities

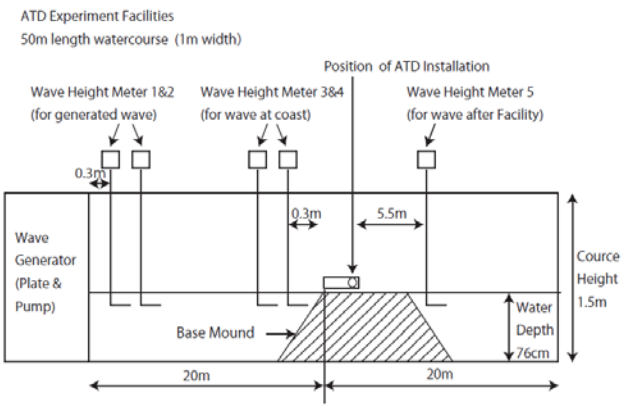
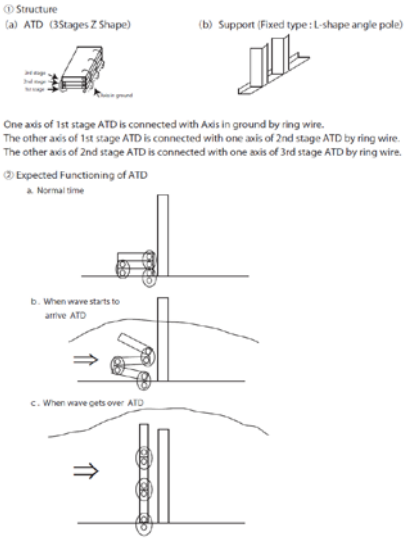


Figure 2: ATD Model



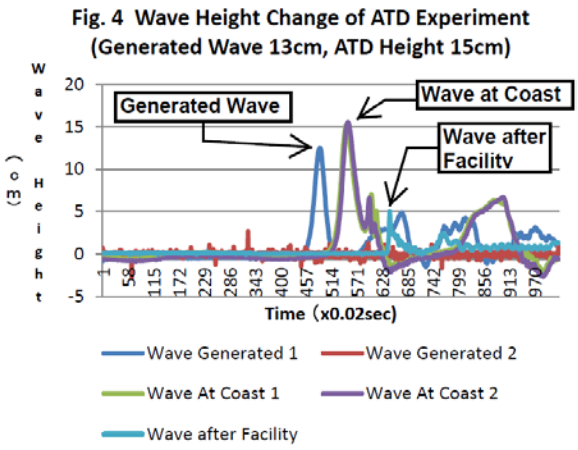
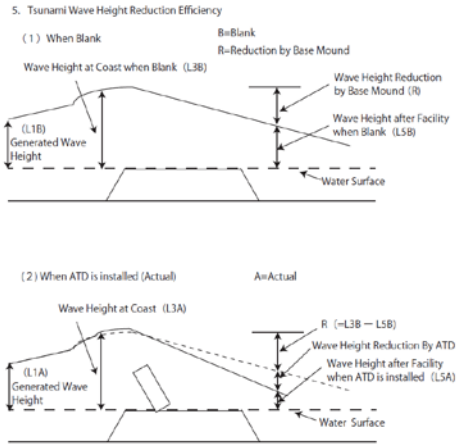


Fig. 5 : Figures for Calculation of Tsunami Wave Reduction Efficiency



Tsunami Wave Reduction Efficiency

= (Wave Height Reduction by ATD) / ((Wave Height at Coast)-(Wave Height Reduction by Base Mound)

= (L3A - (L3B - L5B) - L5A) / (L3A - (L3B - L5B)) …… （1）

2. Experiment Results

Photos 1 : Sequential Photos of ATD Experiment (When Generated Wave Height = 10 cm & ATD Height= 15cm）

(1) Before Soliton Wave arrive :

(3) Approx. 0.56 sec. after the wave arrive:

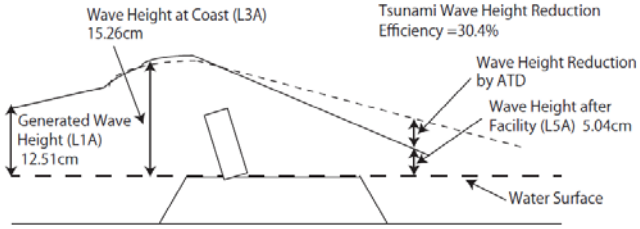
(2) Approx. 0.43 sec. after the wave arrive:

(4) Approx. 0.86 sec. after the wave arrive:

Table 1 : Experiments Data of ATD

No.	Description	Gen. Wave	Wave at Coast	Wave after Facility	Wave Reduction Efficiency
2-1	ATD Small When Function	12.41 cm	15.31 cm	4.78 cm	34.5%
2-2	ATD Small When Function	12.51 cm	15.26 cm	5.04 cm	30.4%
2-3	ATD Small When Function	12.48 cm	15.25 cm	5.27 cm	27.2%
2-4	ATD Small After Function	12.48 cm	14.89 cm	4.83 cm	29.7%
2-5	ATD Small After Function	12.18 cm	14.45 cm	4.60 cm	28.5%
2-6	ATD Small After Function	12.53 cm	15.29 cm	5.10 cm	29.9%
1-3	Blanc	12.78 cm	15.29 cm	7.28 cm	

Fig. 8 : Figure of max. wave heights when generated wave height is 13cm & ATD is functioned



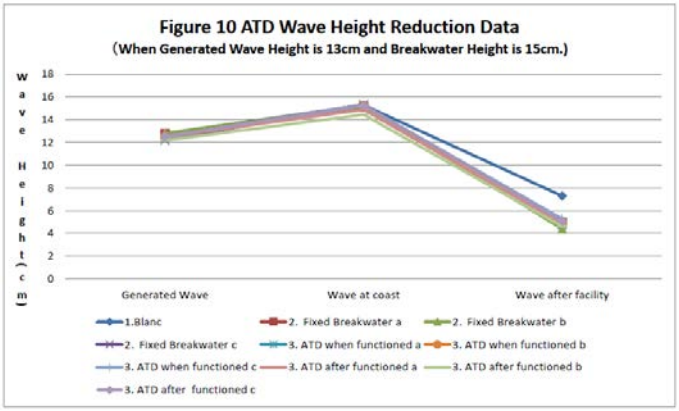


Table 6 : ATD's Wave Reduction Efficiency

No.	Description	Ave. Reduction Efficiency
3-1 ~ 3-3	Solid Breakwater	34.9%
2-1 ~ 2-3	ATD Small When Function	30.7% (Approx. 88% of that of Fixed breakwater)
2-4 ~ 2-6	ATD Small After Function	29.4% (Approx. 84% of that of Fixed breakwater)

3. Conclusion : It had been confirmed that ATD has the following 3 features:

(1) ATD is actioned automatically by wave which gets over it, by buoyancy of wooden structure, and will be functioned as breakwater in the flooded water.

(2) The action time since when ATD is laid down at normal time to when ATD is functioned as breakwater is less than 1 second and ATD's tsunami height reduction efficiency when ATD is functioned is more than 80% of that of solid breakwater (watertight) of the same height. And it is found that ATD has a better tsunami height reduction efficiency when it is moving from the laid down position than after it was already functioned as breakwater 'i.e., after it was stood), so that ATD will have more than 80% tsunami reduction efficiency of solid breakwater of the same height.

(3) ATD's wooden structure has no robustness problem in this scale of model experiments