P41

Tsunami Evacuation Model and Applicability of Platform-type Tsunami Evacuation Tower

○Keita TAMARI, Tetsuya HIRAISHI

In this study the platform-type tsunami evacuation tower is suggested, which is inspired from the only one pine tree left after the tsunami of the Great East Japan Earthquake. The tsunami force acting on the tower is expected to be reduced because the drag coefficient of cylindrical shape might be smaller than that of rectangular shape. It is also good to construct the platform-type tsunami evacuation tower with respect to the construction time and cost. The prototype of tower is capable to be manufactured in a factory and to be carried to the site. Therefore, it meets the increasing needs of tsunami evacuation tower in the coastal areas. The wave pressure acting on a cylindrical structure is evaluated by Asakura's formula. However, the mechanism of the wave pressure acting on the onshore cylindrical structure has not ever been found out clearly because the impulsive wave pressure caused by wave breaking must be taken into account. For the construction of the platform-type tsunami evacuation tower, it is an urgent issue to clarify the wave force distribution on the onshore cylindrical structure.

1. Introduction

The 2011 East Japan Great Earthquake with the magnitude 9.0 was one of the most powerful earthquakes in the known history, and the huge tsunami that followed the earthquake caused massive damages to coastal areas in Tohoku and east Kanto regions in particular. The Nankai megathrust earthquake is expected to occur in the near future, which can be beyond the level of the Great East Japan Earthquake. If the magnitude 9.0 level Nankai megathrust earthquake occurs, it is estimated that the tsunami height will be over 15m in the coastal areas of Shikoku-island and Kii-Peninsula and also the dead will be up to about 320,000 people. Such a huge scale tsunami that mentioned above is categorized as "Level-2 Tsunami", which has not been observed in the last few thousands of years, but if it occurs, there is a danger of causing massive damage. Considering "Level-2 Tsunami", the "disaster reduction" is an effective way to be saved from tsunami, while the disaster prevention is the general countermeasure. This concept focuses on the minimization of the damage, supposing "Level-2 Tsunami". Then the tsunami evacuation tower has been established as one of the effective evacuation facilities in the coastal area. The tsunami evacuation tower is an emergency shelter for local residents to evacuate in. For reasons, such as the limited time to the arrival of the tsunami and geographical conditions, the tsunami evacuation tower is built in area where evacuation to nearby safe place is expected to be difficult. While new construction needs are rapidly increasing, problems of the renovation of existing tsunami tower become remarkable at the same time.

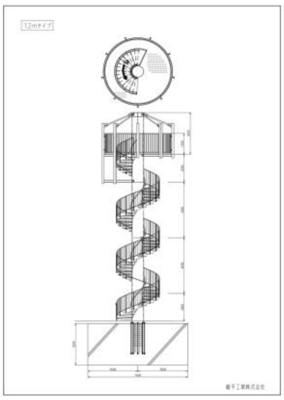

Fig.1-Platform-type Tsunami Evacuation Tower

2. Evacuation Simulation

In order to reproduce the evacuation behavior from the beach, we developed an evacuation behavior simulation program using the multi-agent model. The agent selects their own actions according to their respective value criteria and act on evacuation behaviors. First, they determine the visible range. Secondary the agent is moved to the target of evacuation by deciding the walking speed from the distance to the nearby person. This flow was repeated to calculate evacuation behaviors towards the set evacuation site. By constructing an evacuation simulation model for S-beach, clarify how bottleneck occurs when the number of tsunami evacuation towers is insufficient and demonstrate the necessity for a small tsunami evacuation tower. And we tried to propose an optimal evacuation measure related to safety evacuation of beach users.

Evacuation simulation was conducted, and the following results were obtained. (**Fig.2**)

- ✓ Regardless of the number of evacuees, the evacuation speed of the first group was almost constant
- ✓ However, when the number of evacuees was big, the evacuation speed of the last group was slow
- ✓ There was almost no difference in the trend of choosing evacuation routes

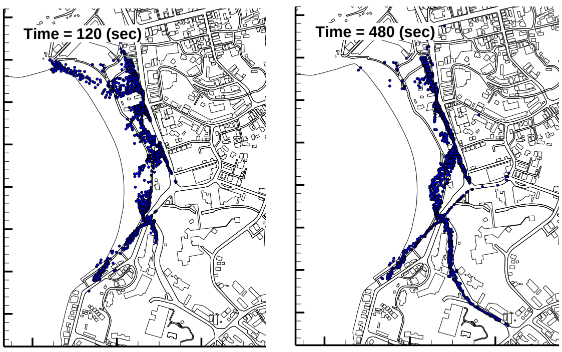

Fig.2-Examples of the simulation result

3. Tsunami Force Analysis

In the experiment, the actual Sea Model Basin was used, which is in the Ujigawa Hydraulics Laboratory of Disaster Prevention Research Institute (DPRI), Kyoto University. In the basin, the temporary experimental water channel was constructed with concreate brocks. The dimensions of the water channel were 9.5m long and 0.5m wide, and the wave generating apparatus of “the actual Sea Model Basin” was used. The schematic view of the water channel is shown in **Fig.3**. The model scale was assumed to be 1/20.

Table.1-Experimental conditions

Item	Condition
Scale	1/25
Incident wave	Soliton wave
Height of incident wave(cm)	6.0(wet condition), 8.0, 10.0, 12.0, 14.0
Water depth(cm)	40.0(dry condition), 42.0(wet condition)
Position of tower	ahead(10cm from shoreline) behind(26cm from shoreline)
Sampling frequency	100Hz
Number of data	2048

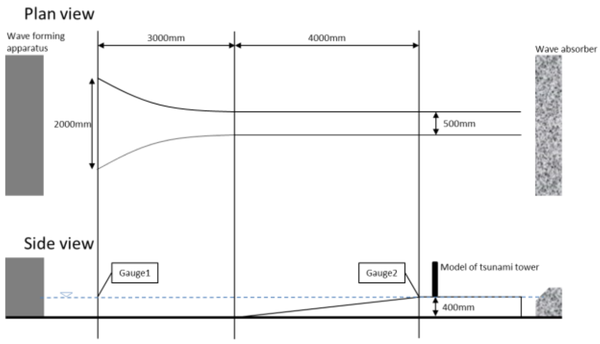

Fig.3-Schematic view of water channel

In the case of dry condition (assuming the first wave of tsunami), the wave pressure acting on the tower was not reduced compared to Asakura’s formula. Because, in this experiment, wave pressure during wave breaking was recorded. Based on these results, it is possible to design a tsunami evacuation tower having necessary and sufficient strength.

4. Application of Platform-type Tsunami Tower

It is expected that the platform-type tsunami evacuation tower will be effective for eliminating bottlenecks and works as an evacuation guide for evacuees. However, as the number of evacuees that the platform-type tsunami evacuation tower can contain is limited, comprehensive measures combined with large-scale tsunami evacuation facilities are necessary.