

Features of Anti-Tsunami Door (ATD)

Anti-Tsunami Door (ATD) has the following 3 major features:

1. Breakwater of New Concept
2. Automatic operation
3. Unit structure

The details are as below:

1. Breakwater of New Concept

The system using ATD apply a new concept of breakwater, because the current concrete-made breakwater cannot ECONOMICALLY reduce the hazard of large tsunami.

The current concrete-made breakwater is based on the concept to shut out the impact of tsunami up to the required tsunami height, then it is required to have sufficient robustness against high water flooding on one side with keeping no water on the other side. So when the expected tsunami height becomes higher, the breakwater becomes taller and thicker, and its required foundation becomes wider, deeper and more robust, then the required cost becomes so huge and the application results in budget problem.

In the system using ATD, the concept is changed to **“Functioning in the flooded water and Disturbing the major parts of following tsunami with Allowing minor invasion of water flooding.”**

In this concept, **the efficiency of hazard reduction will be less than the current breakwater**, because it allows some flooding invasion, but it is expected the hazard reduction of almost the same level against the continuously following tsunami because it functions continuously as breakwater in the flooded water. By applying this concept, the system **does not require high strength of foundation and breakwater structure**. So we can adopt **wooden-made structure for the system and construction economics will be improved significantly, cost benefit factor becomes greatly improved**. Additionally using wood is **environmental friendly**.

It is also considered that the application of ATD is **optimum for level 2 tsunami** because it has rare frequency but requires astronomical height of breakwater.

Additionally this ATD have secondary function, such as it will **contain flooded water inside of the structure and waste the tsunami energy** utilizing it for lifting the ATD structure (with contained water) to the standing position.

2. Automatic operation

ATD is contained in the ground surface, etc., and automatically operated at the case when tsunami floods, and functioned as breakwater. This is the top feature of ATD.

The current standard breakwater of concrete-made is not functioned, so it requires a tall, thick and huge structure (such as 10m height, more than 1m thickness), specially when its corresponding tsunami height is higher. Then it greatly limits the view sight and significantly disturbs the living circumstances of fisherman, worker at port, tourist and residences of the

area. When a huge tsunami flooded at the earthquake disaster of East Japan (March 11, 2011), Taro town in Iwate Prefecture, which had double 10m tall concrete-made breakwater, suffered the problem that the residents could not be aware of the tsunami flooding properly and some city officer who took care of functioning breakwater experienced danger of life.

On the other hand, the ATDs which are **contained in ground surface, quay wall, etc., as compact conditions during normal time**, will stand up automatically in the flooded water and functioned as breakwater. So the residents **can aware of the conditions of tsunami flooding** and no need to go to the coast area to function parts of breakwater (such as closing the door inside the breakwater). Also this ATD system **almost neither limit the sight of coast area nor disturb the living circumstances of fisherman, worker at port, tourist and residents of the area**. Additionally the ATD system can be installed as walk way in the beach, and matches with the sight and living activities of the related persons.

3. Unit structure

The third feature of ATD system is “It adopts unit structure”.

The current concrete-made breakwater, if constructed per high tsunami, requires tall and thick structure and wide and deep foundation near the sea coast. Its construction requires huge of local work, man power and raw materials. It results in huge budget and big problem of financing.

On the other hand, the ATD is made of unit structure, so it **can be manufactured from standard shape wooden board and pillar in the factory or shop near the installation, which is quite convenient and economical**. The system requires some minor work locally to install ATD at the location but does not require the heavy construction work for large foundation and thick concrete breakwater, so it is **quite simple and economical in the view point of construction technology and budget**.

By adopting the system of multiple folding or multiple layer, ATD system is considered to be applied to the area where large and tall tsunami is expected. And also ATD system can be added on the existing concrete breakwater.

Level 2 tsunami has rare frequency but requires astronomical height of breakwater, so the cost performance of breakwater is extremely important and the system of ATD is **best matching with the application for Level 2 tsunami**.