

Tsunami power  
-Lessons from The Great East Japan Earthquake-

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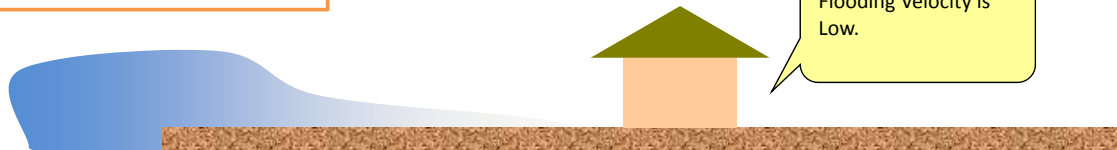
**CHARACTERISTICS OF TSUNAMI  
FORCE ON LAND STRUCTURES**

## Difference with overflow above the seawalls (wind waves & tsunami)



## Type of Tsunami Force

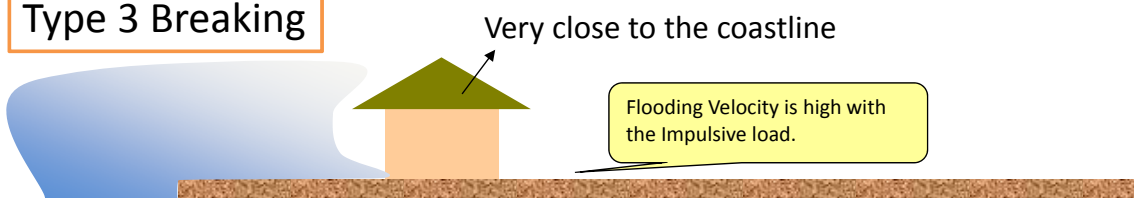
Type 1 Overflow



Type 2 Bore



Type 3 Breaking



IF the Height of Tsunami is same, then breaking is the maximum.

Large

## Overflow (Miyako Port)



Miyako weather TV (by NHK)

## Bore (Sand beach at Sendai)



By NHK

# Breaking (Kuji fishery port)

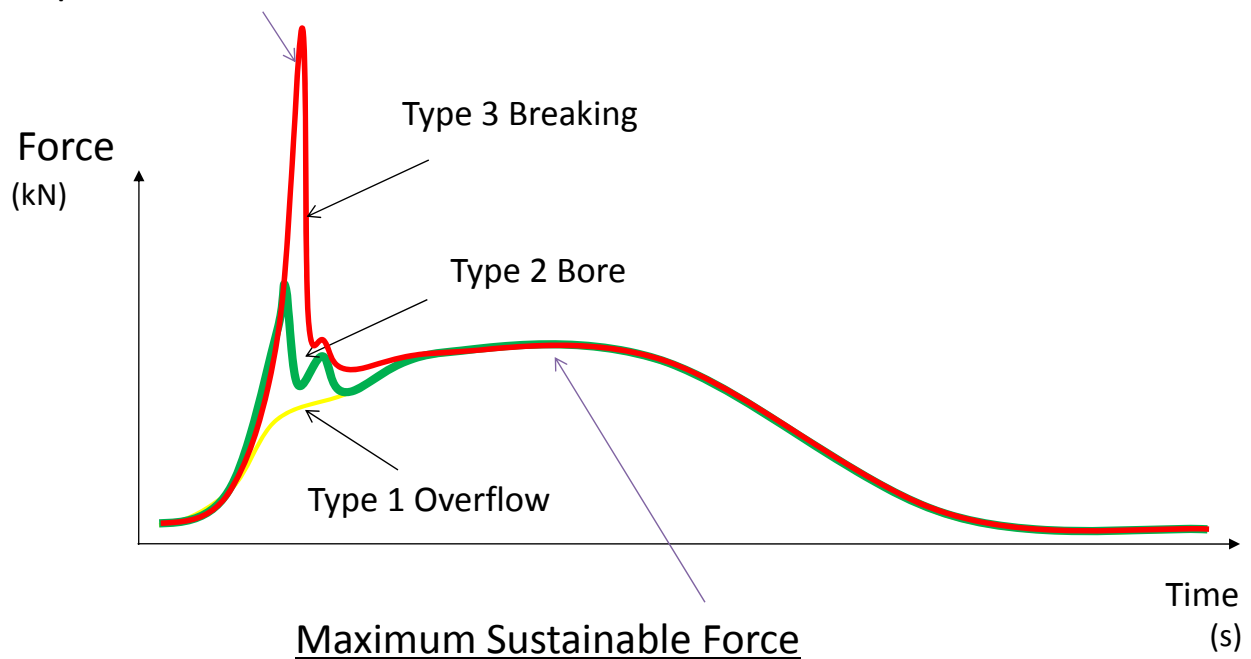


taken by a residence



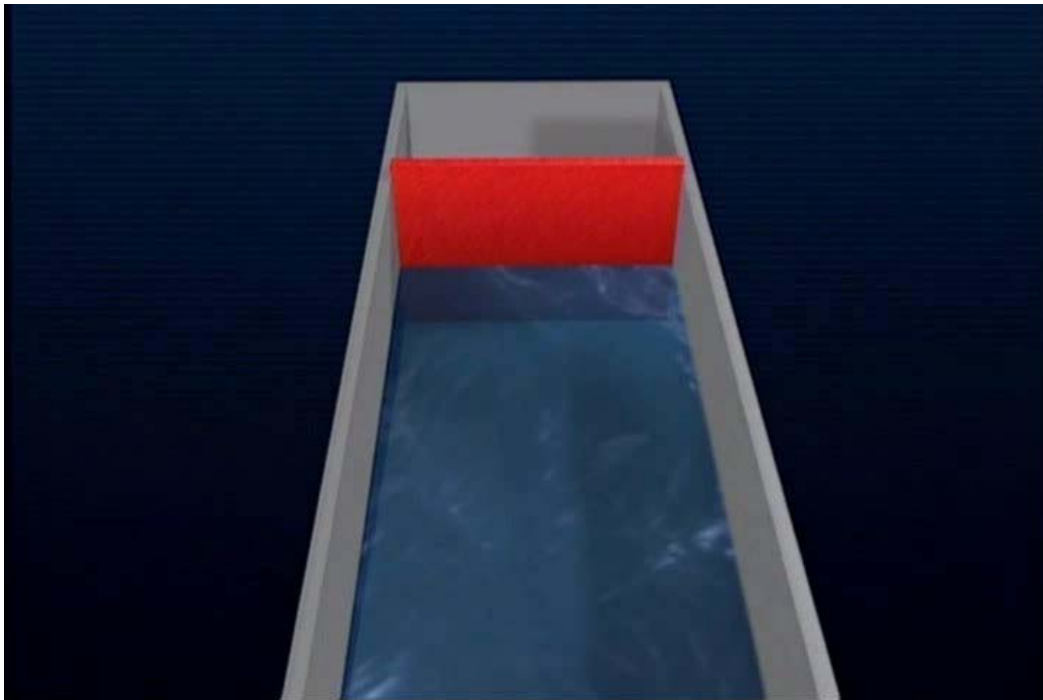
# Typical time histories of tsunami Force

## Impulsive Bore Force





## Motion of Wave Puddle



## The power of Breaking type

Wooden board (thickness is 3 cm)

Height of Tsunami in front of the wall is 1.2m



High speed camera



TV Program Science Zero (NHK, 17<sup>th</sup>/06/2005)

## Bore Type Tsunami



Tsunami Height in front of the wall is 2.0m

## Example of destruction of Wooden house (at Natori, Miyagi)



# Destruction of concrete wall by tsunami impulsive wave force

thickness 60mm



## High speed camera

Thickness=75mm





## Example of destruction of concrete wall (at Onagawa, Miyagi)



Thickness is 18cm

## FAILURE MECHANISM OF BREAKWATERS

# Kamaishi Tsunami Breakwater



## North side of Kamaishi breakwater



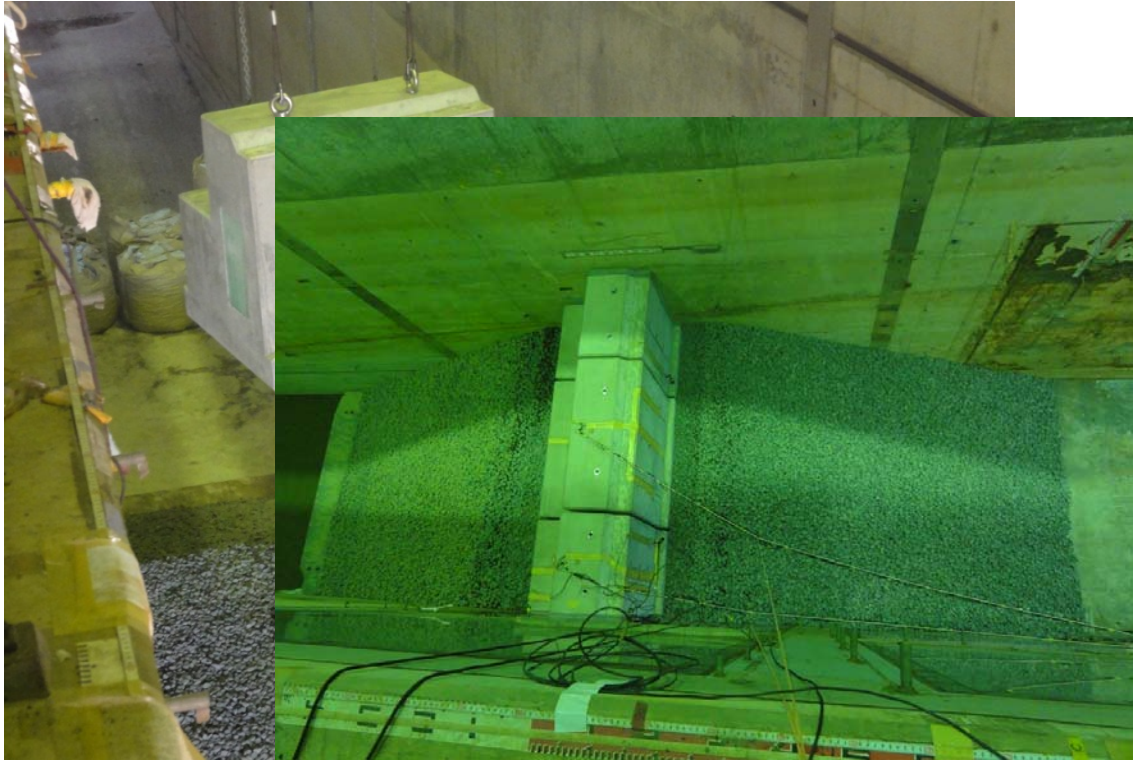


# Experimental Setup

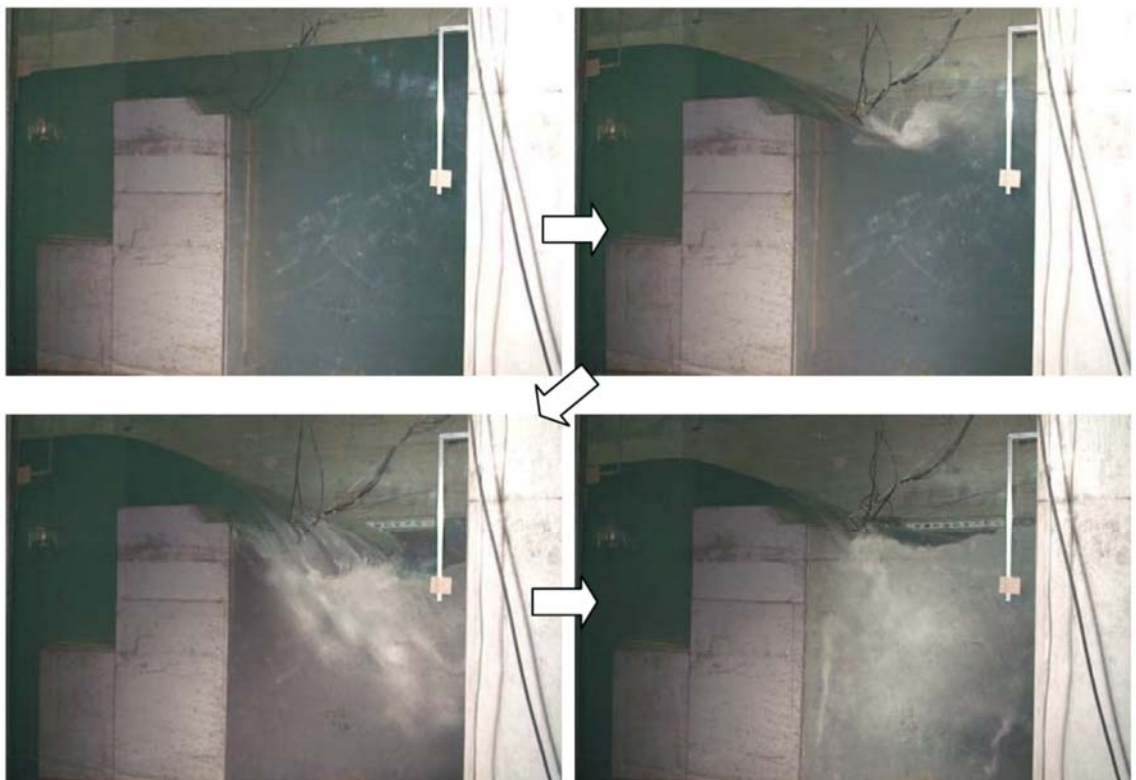
Model scale is 1/20,

The height of rectangle caisson is 1.4m

The height of trapezoid caisson is 1.65m



How to make the overflow by using circulation pump



## Experimental Video under overflow tsunami



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## Experimental Video under overflow tsunami

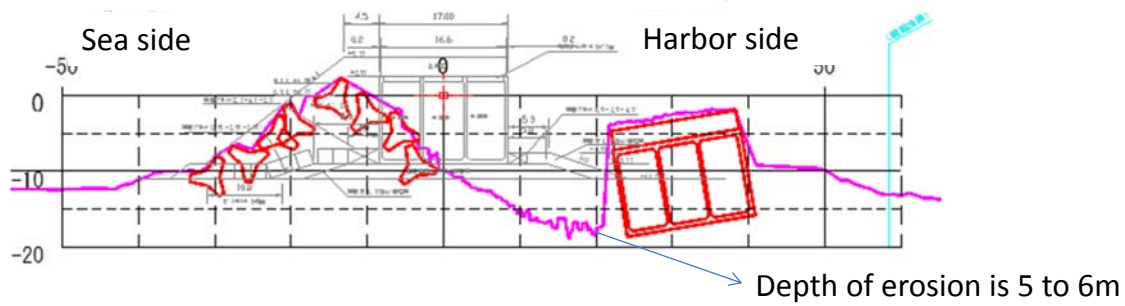
Bird View



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## Influence of scouring at rear side due to overflow at Hachinohe port



Sea side

Model scale is 1/25

Video speed is  
5 times as real

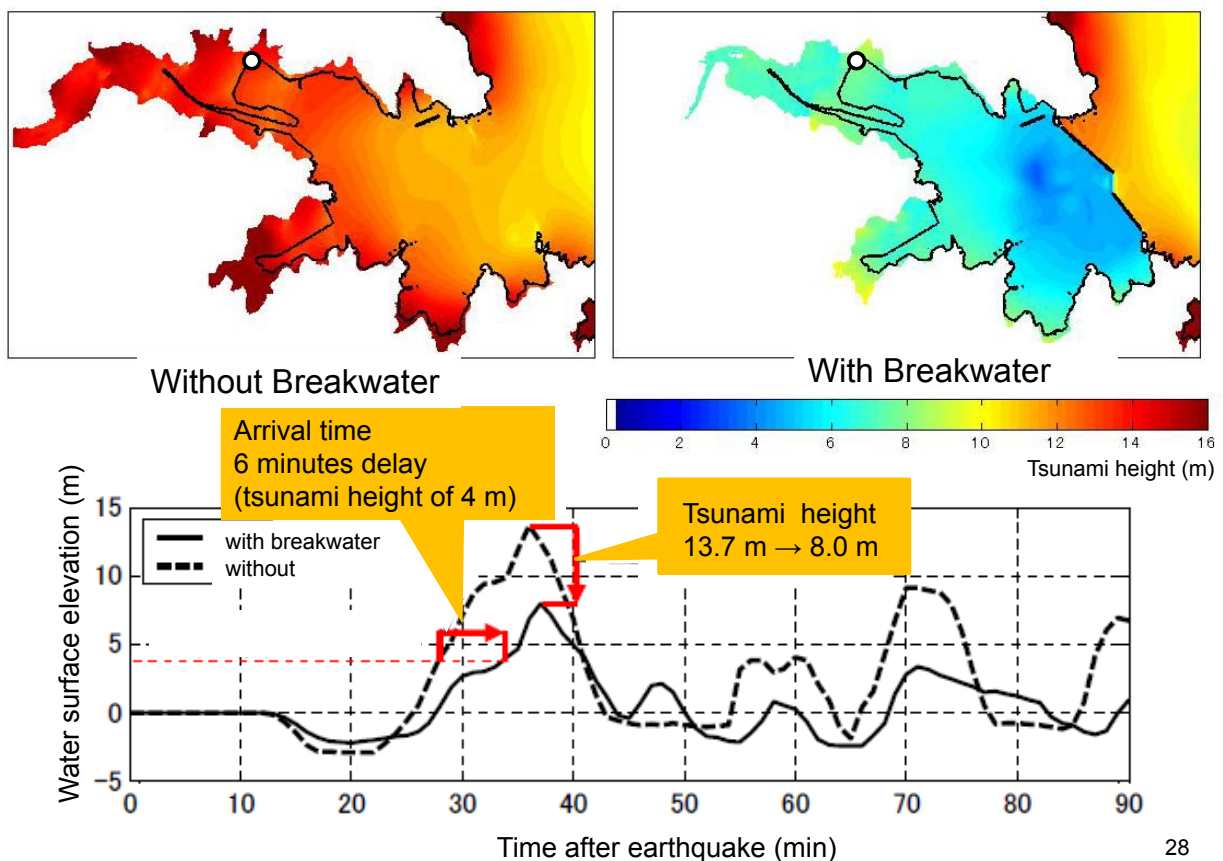
# FOR EVACUATION

# Against Human body



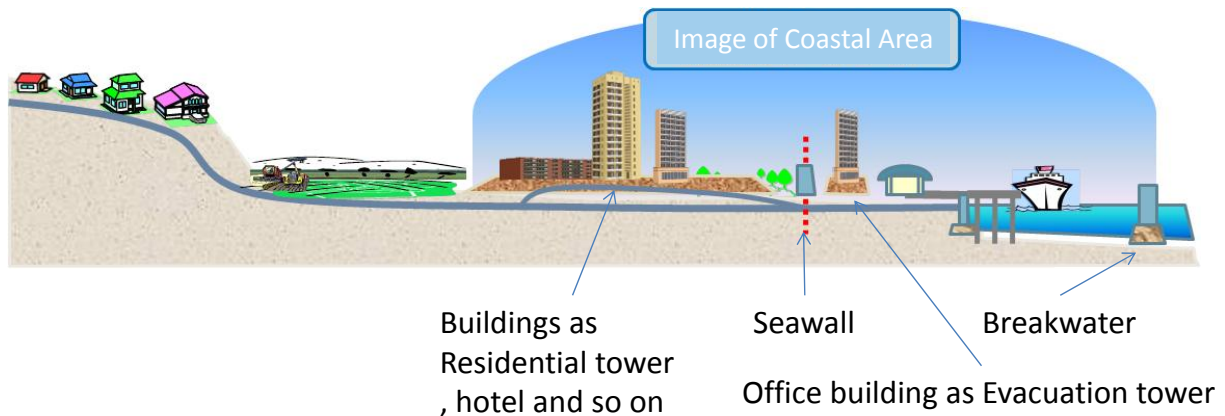
Inundation height is about 50cm, Inundation speed is about 4.0m/s

## Effect of breakwater (Dr. Tomita et. al, 2012)



# Resilient city against Tsunami

**"hardware"** (disaster prevention facilities, etc.) and **"software"** (disaster prevention training, etc.) **measures**



multiple protective structure

# Lessons from The Great East Japan Earthquake

- The power of the tsunami is greatly different depending on the place and the condition
- The breakwater and seawall cannot prevent the tsunami perfectly, but can help people to evacuate.
- It is important to mitigate the tsunami disaster by using the hardware and software measures.
- Even if the tsunami is very small, people may be washed away by tsunami.

Thank you for your attention

