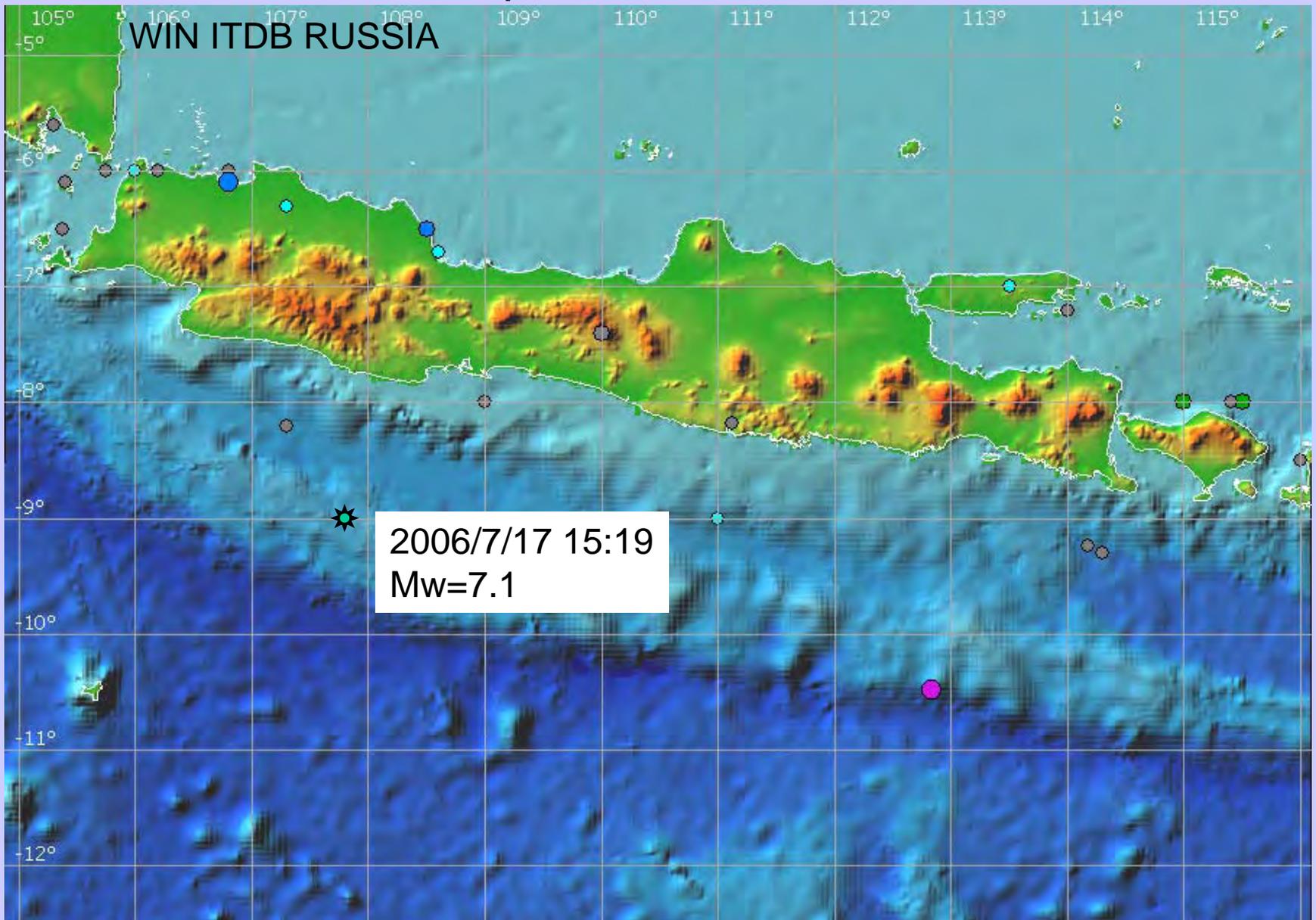
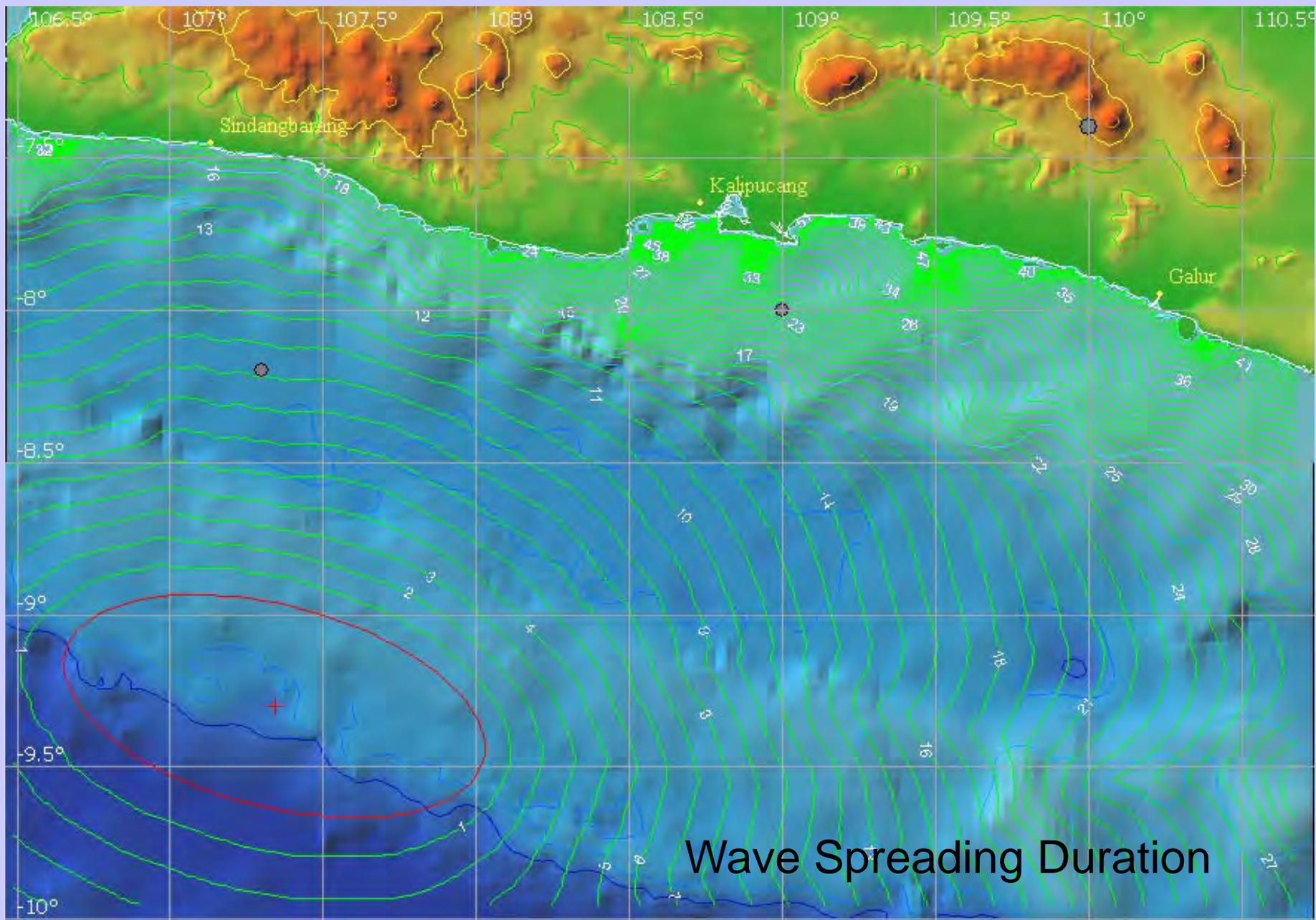


2006年7月17日

West Java Earthquake

West Java Earthquake





Wave Spreading Duration

Jl. Pramuka 測線



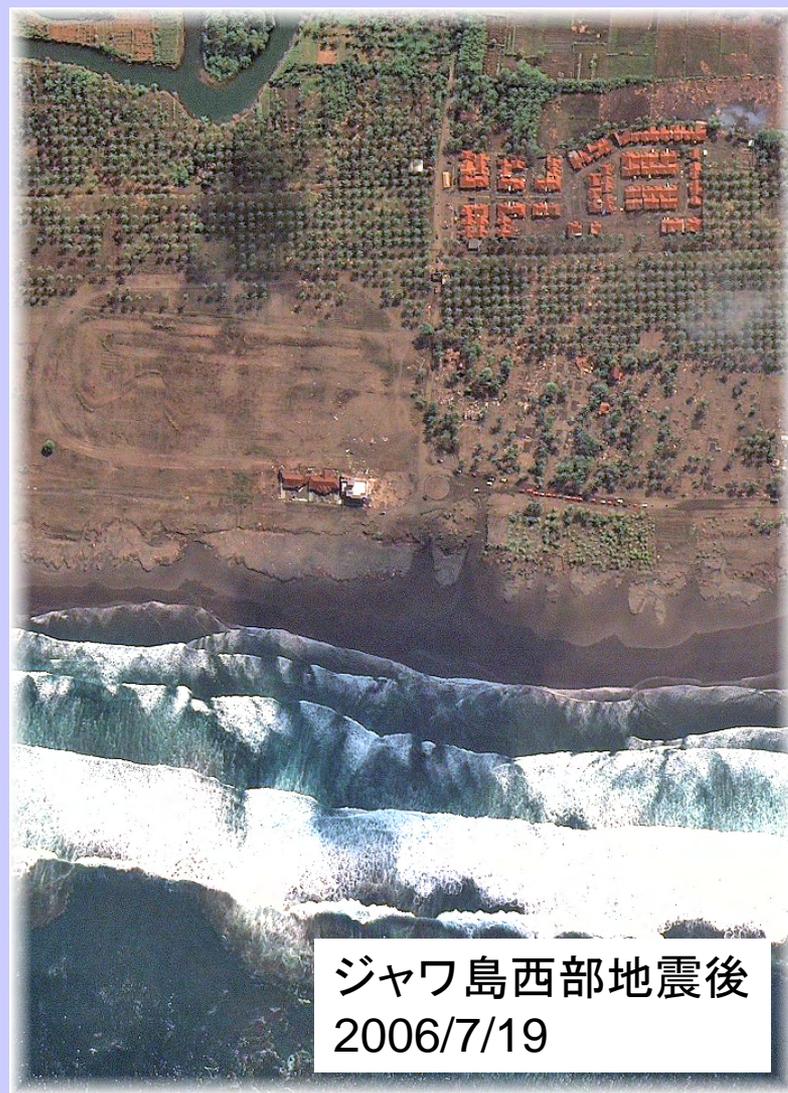
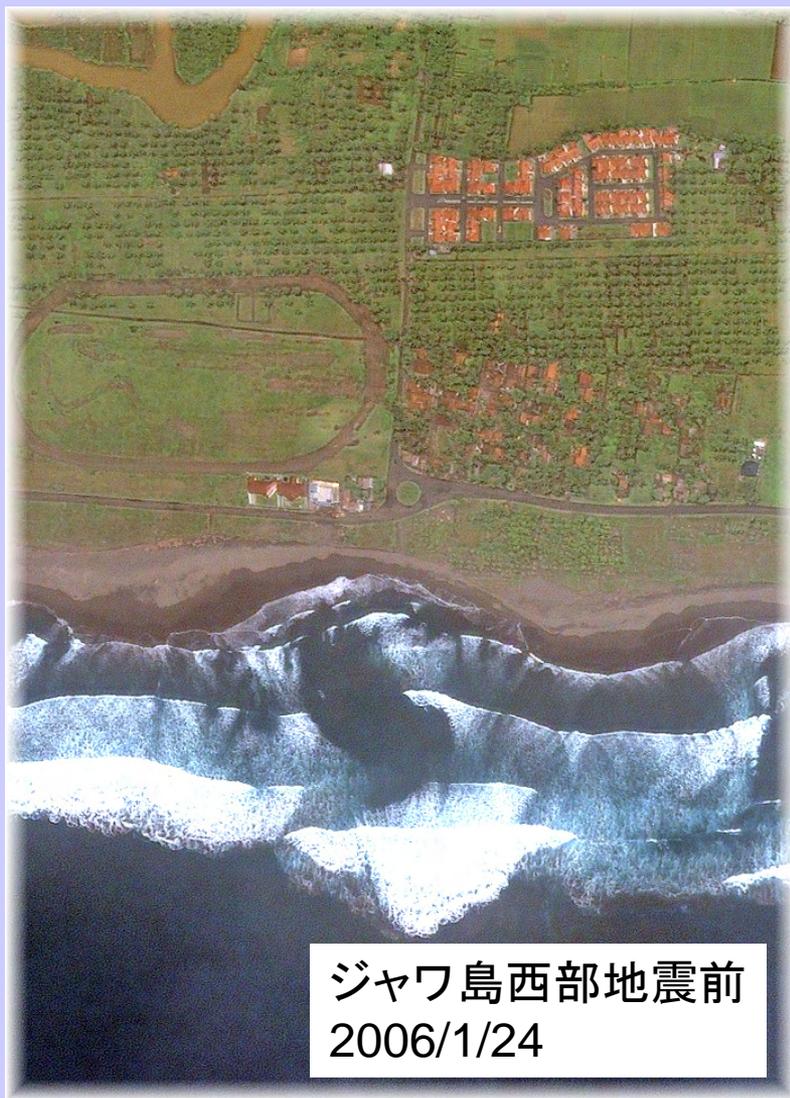
Cikembulan

CRISP, National University of Singapore

<http://www.crisp.nus.edu.sg/>

coverages/tsunami20060717/view20060719_2.html

IKONOS画像



Jl. Gang Mesjid側線



Cikembulan (Gang Mesjid St.)



比較的フラットな地形. 海岸から320m程度まで浸水.

Tsunami Questionnaire Results in Pangandaran

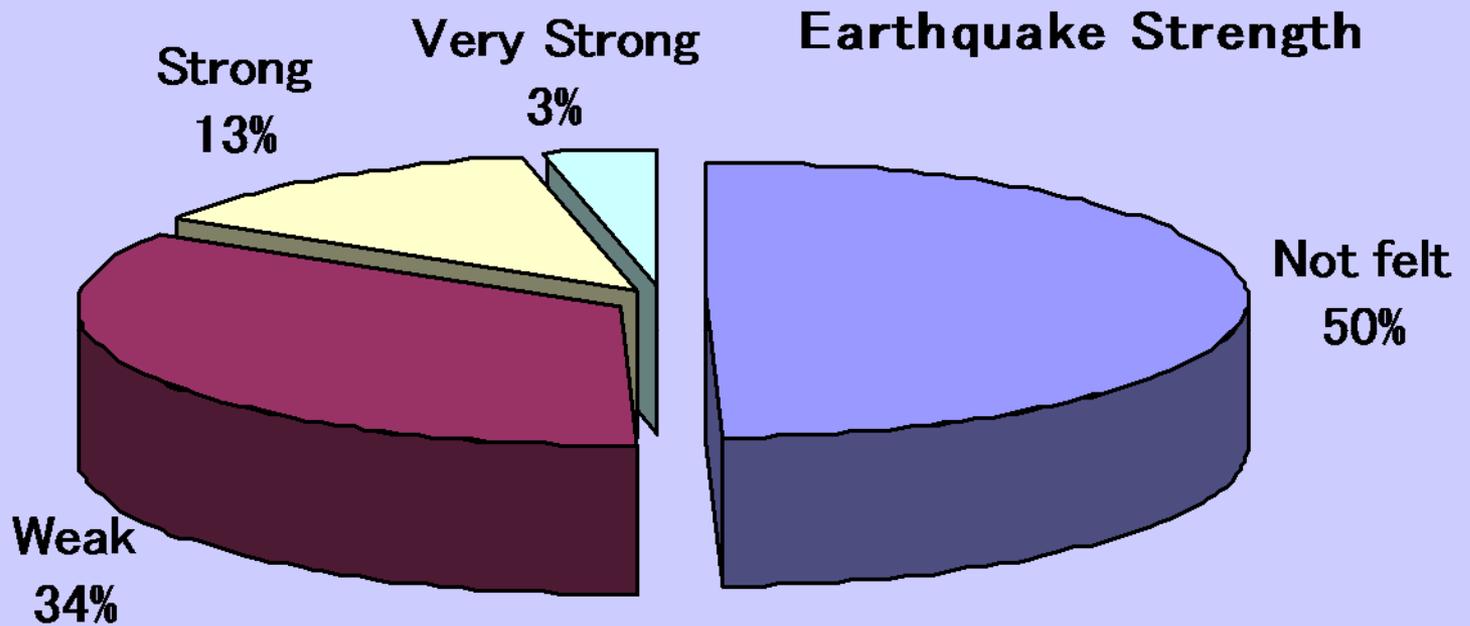
Iemura, Takahashi, and Tobita (Kyoto University)

Wayan Sengara and Krishna Pribadi (ITB)

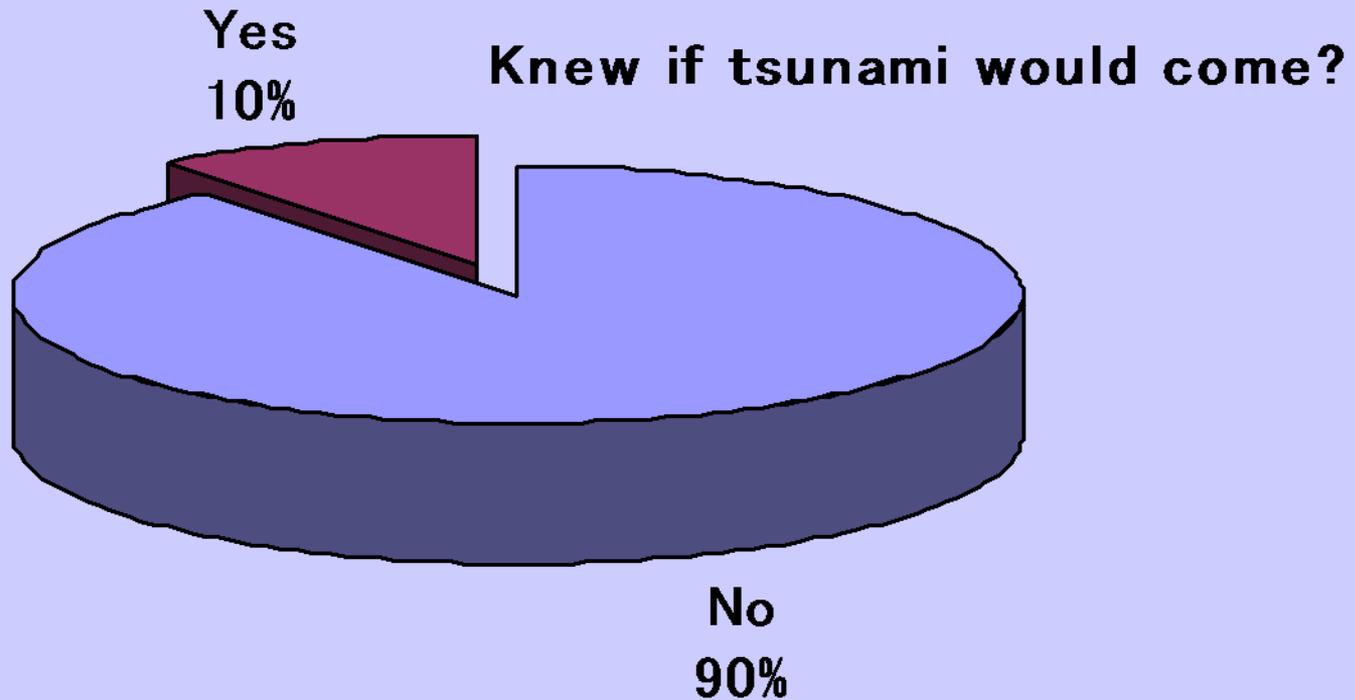
Questionnaire Survey Areas



Earthquake Strength

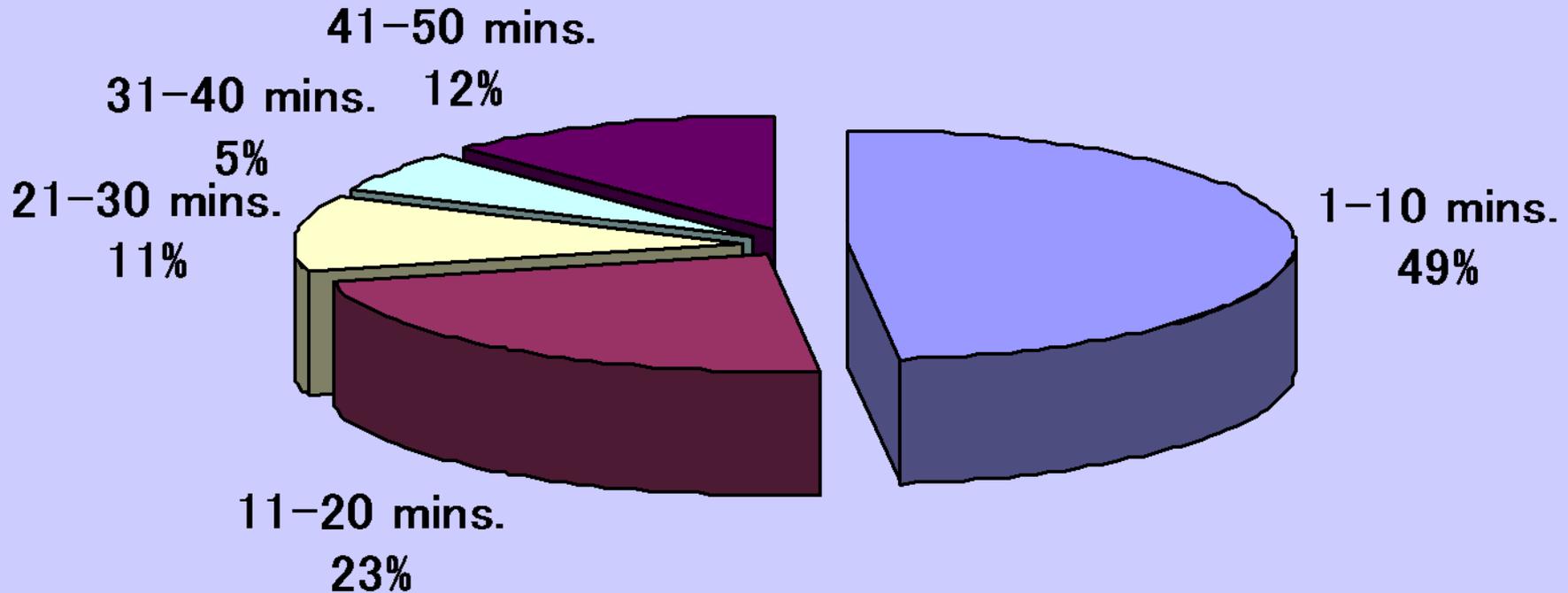


Knowledge on Tsunami



How long tsunami came after the earthquake

How long tsunami came after the earthquake?



What to did you do

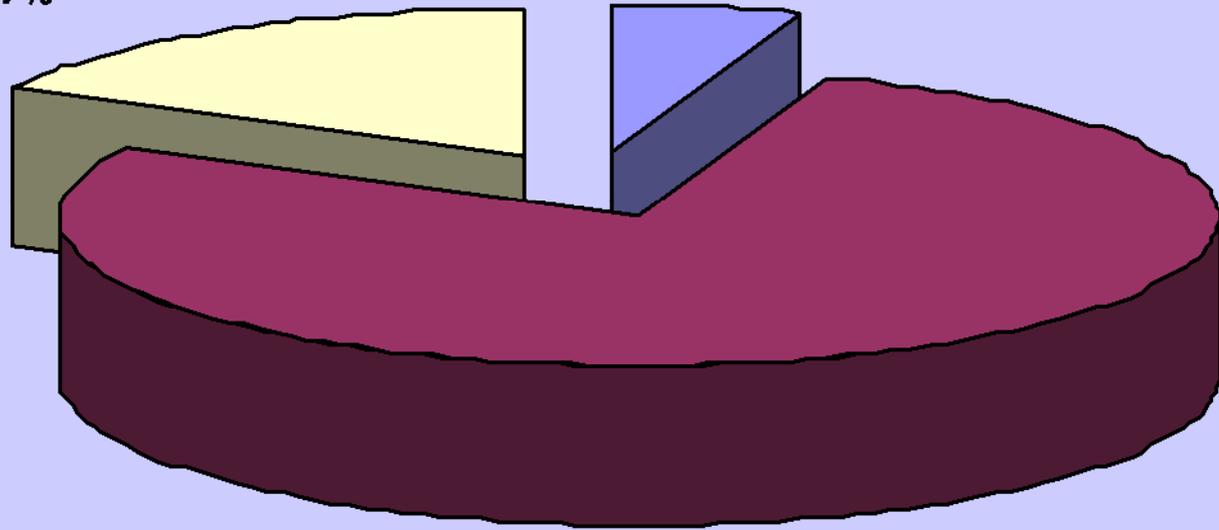
What did you do when knowing tsunami is coming?

Ran away before
tsunami came

17%

Stay at home

5%

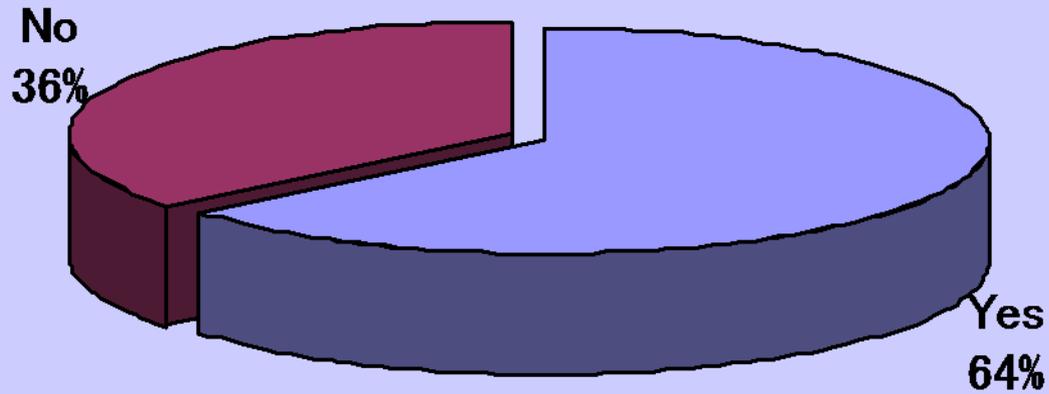


Ran after
seeing tsunami

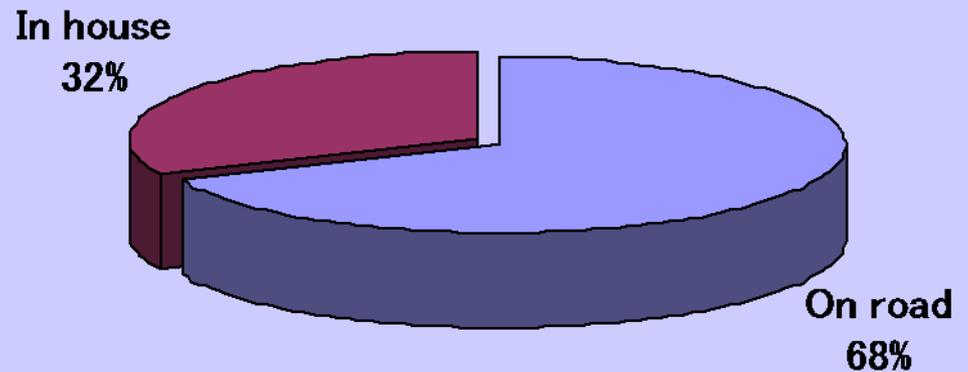
78%

Caught in Tsunami?

Caught in a tsunami water?

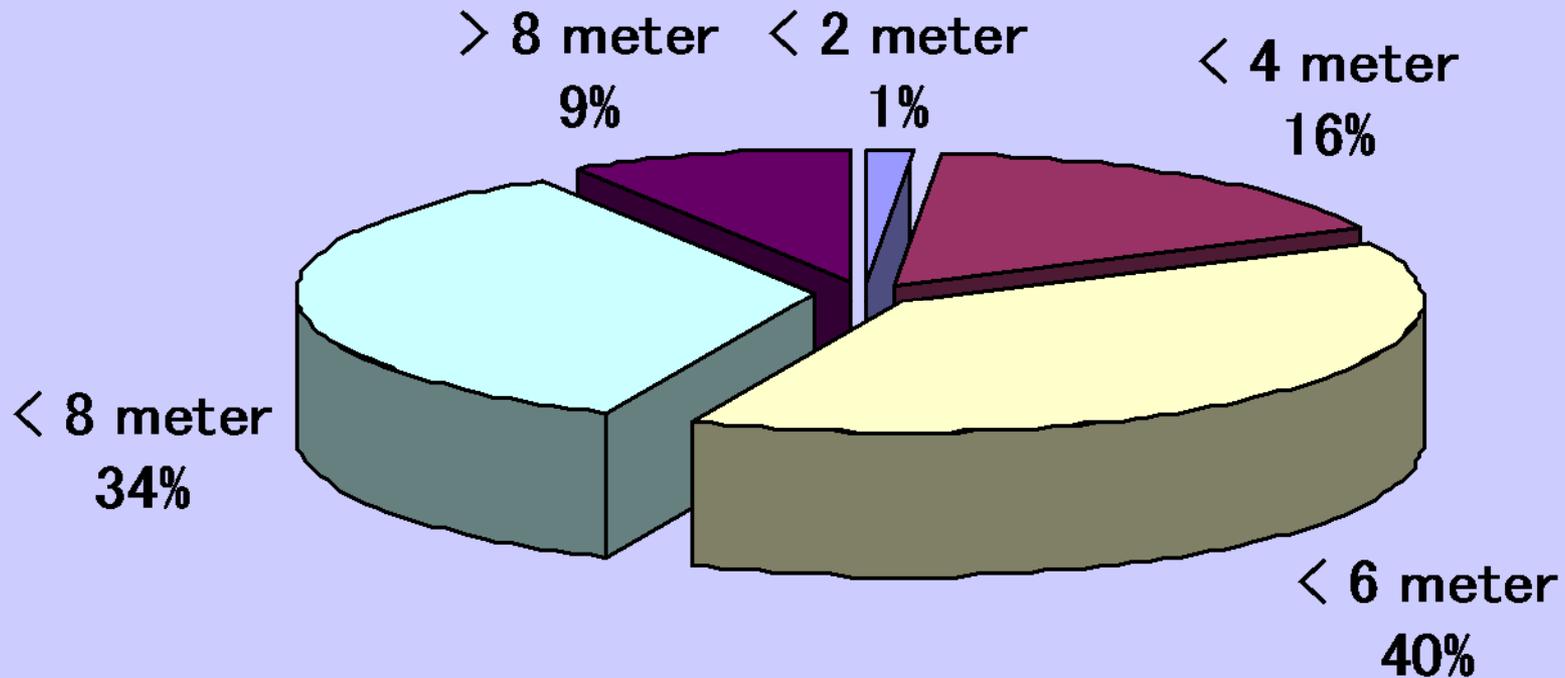


Where?



Maximum tsunami flow on land?

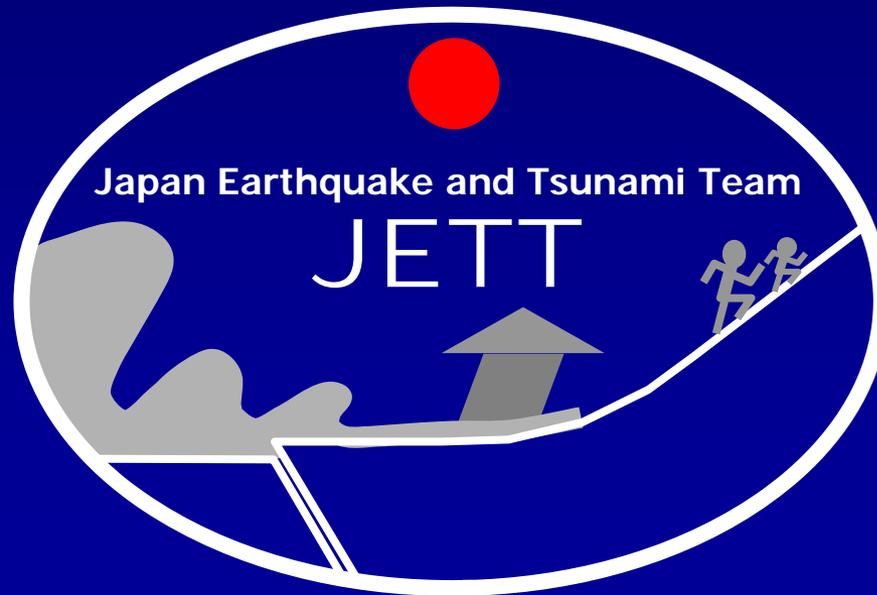
Maximum height of tsunami?



Our Research and Implementation Activities

- Questionnaires for Earthquake Intensity
- Questionnaires for Tsunami Height and Actions
- International Collaboration
- Estimation of Tsunami Force from Bridge Damage
- Water Channel Experiments of Tsunami Attack
- Tsunami Height Memorial Poles and Education

Bridge Damage Survey



Damaged Bridges (March 2005)



Estimated runup height 12 m
Displacement 35 cm



Displacement 85 cm



Displacement 165 cm



Estimated velocity 6m/s (21 km/h)

Estimated runup height 4 m

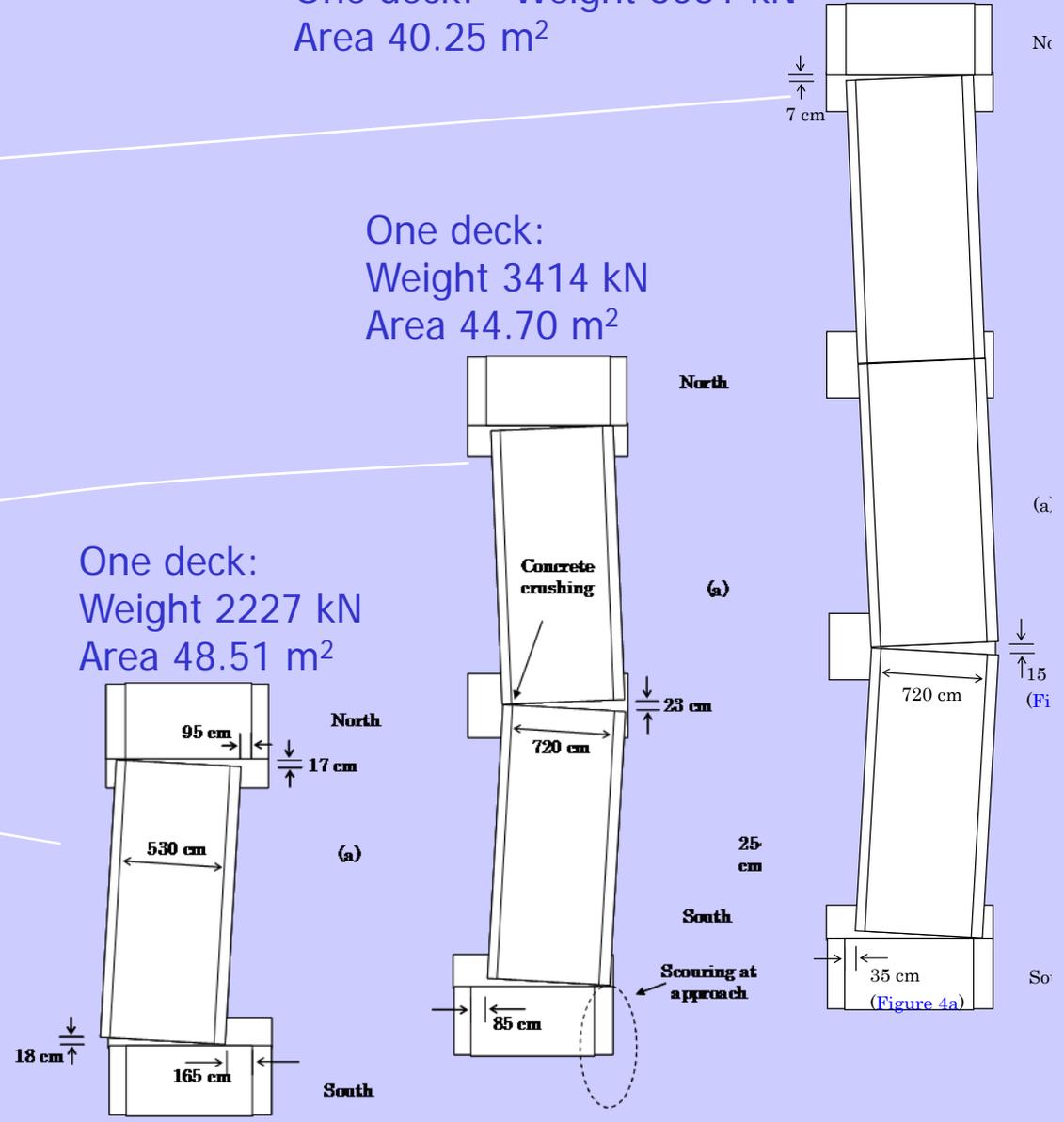


Damaged Bridges (March 2005)

One deck: Weight 3031 kN
Area 40.25 m²

One deck: Weight 3414 kN
Area 44.70 m²

One deck: Weight 2227 kN
Area 48.51 m²



Estimated water velocity that causes a bridge to move

Case Study: No.20
Peukan Bada Bridge

Area of attack, $A = 48.51 \text{ m}^2$

Mass of 3 girders + 1 deck, $m = 227,264 \text{ kg}$

Weight, $W = m \times g = 2,227,187 \text{ Newton}$ $g = 9.8 \text{ m/s}^2$

Resisting force, $F_f = W \times \mu = 668,156 \text{ Newton}$ $\mu = 0.3 \text{ m/s}^2$

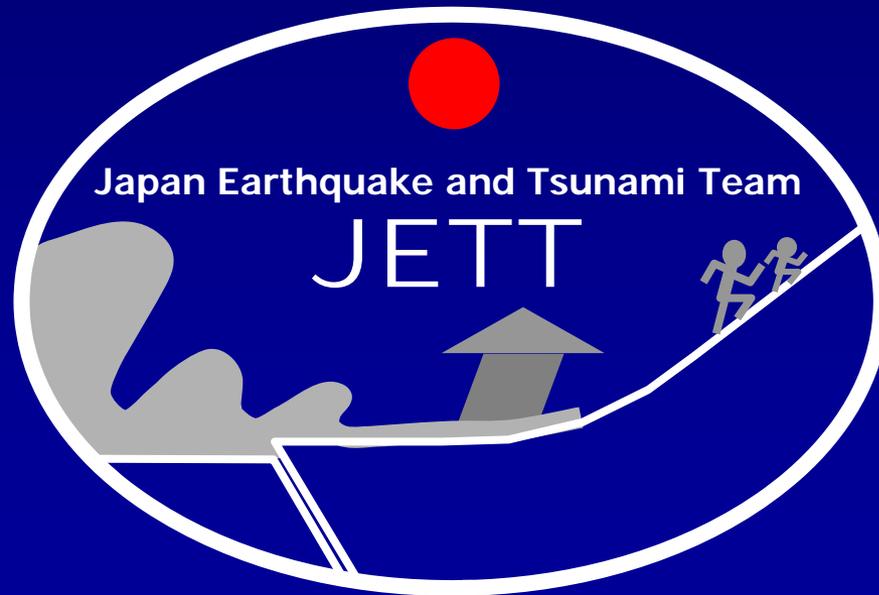
Fluid drag force, $F_d = 0.5\rho C_d v^2 A = F_f$ (bridge start moving)

$$v = \sqrt{\frac{2F_f}{\rho C_d A}} = \sqrt{\frac{2 \times 668,156}{1000 \times 1.0 \times 48.51}} = 5.24 \text{ m/s} \approx 19.0 \text{ km/h}$$

Considering water uplift force, the velocity is calculated as:

$$v_{wu} = 0.775 \times 19.0 = 14.7 \text{ km/h}$$

Experiments on Tsunami Force on a Bridge



Water Channel

- Tsunami experimental tests need to be carried out for:
 - Measuring hydrodynamic force acting on a bridge model, which is a function of the bridge shape, water depth, velocity, and floating debris
 - Obtaining factors responsible for resisting and reducing the hydrodynamic forces for the design purposes



Wave Channel Experimental Facilities at
Ujigawa Open Laboratory, Kyoto University

Bridge Model

Tsunami Waves comes from here

Propeller Type Velocity Meter

Water Height Meter (front of the bridge)



Abutment Model (1:77 Scale)

Bridge Model (1:77 Scale)

Abutment Model (1:77 Scale)

Force Measuring Table

Water Height Meter (back of the bridge)

2006 9 11

Tsunami Runup hitting the Bridge (Debris, Tsu 1)



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