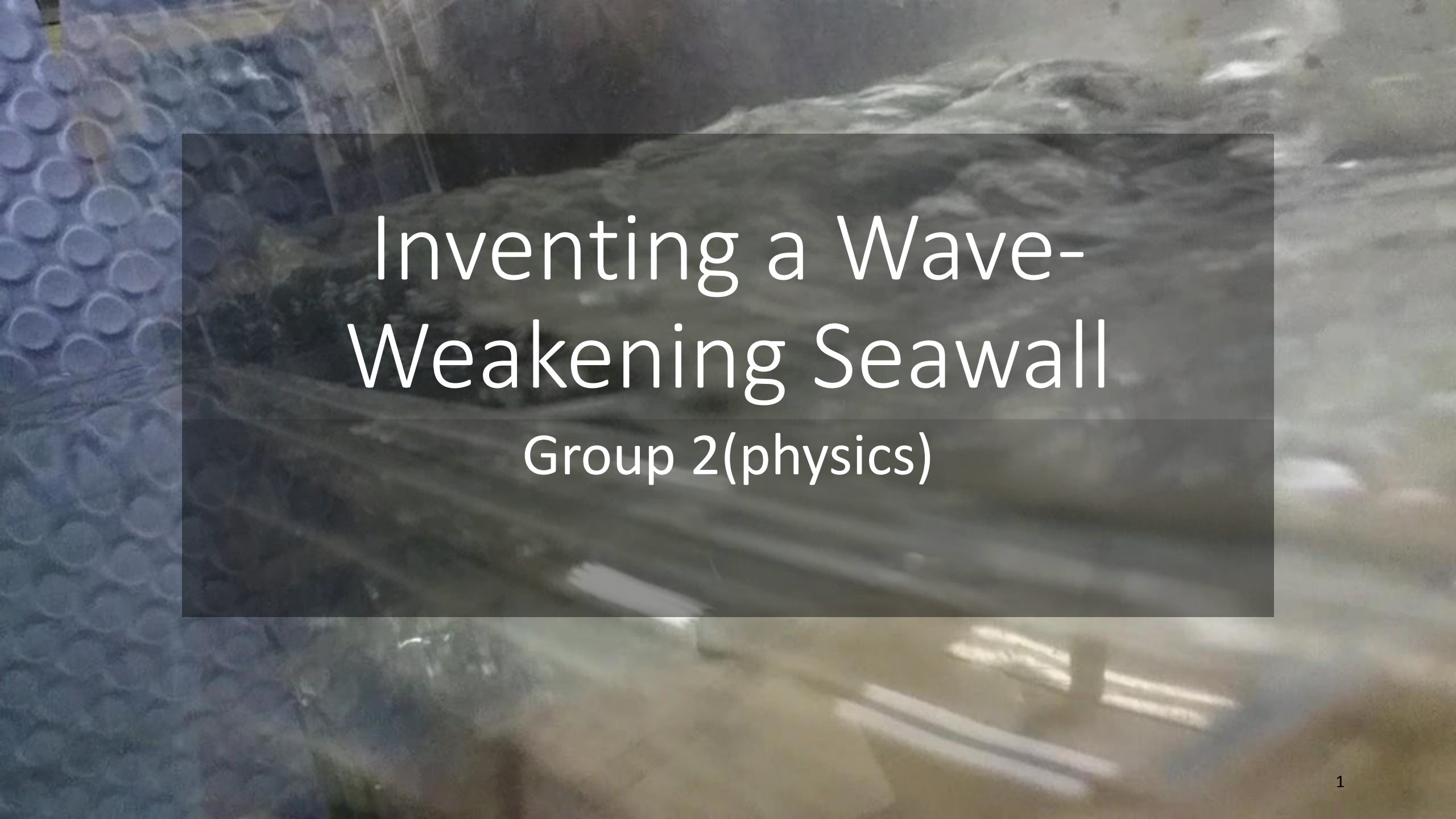


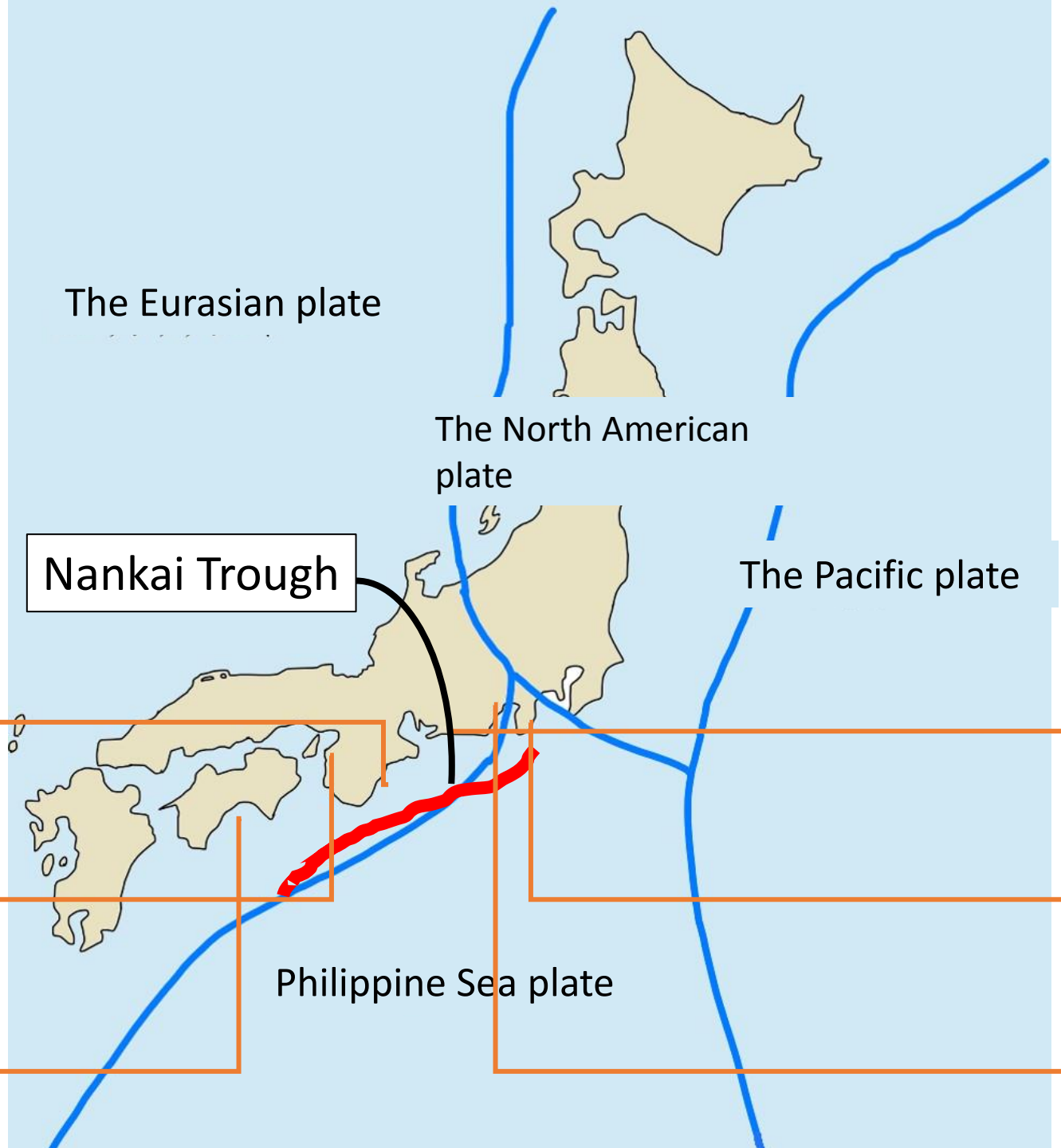
Inventing a Wave-Weakening Seawall

Group 2(physics)

Contents

Purpose

http://www.geocities.jp/niigata_jishin/page23.html

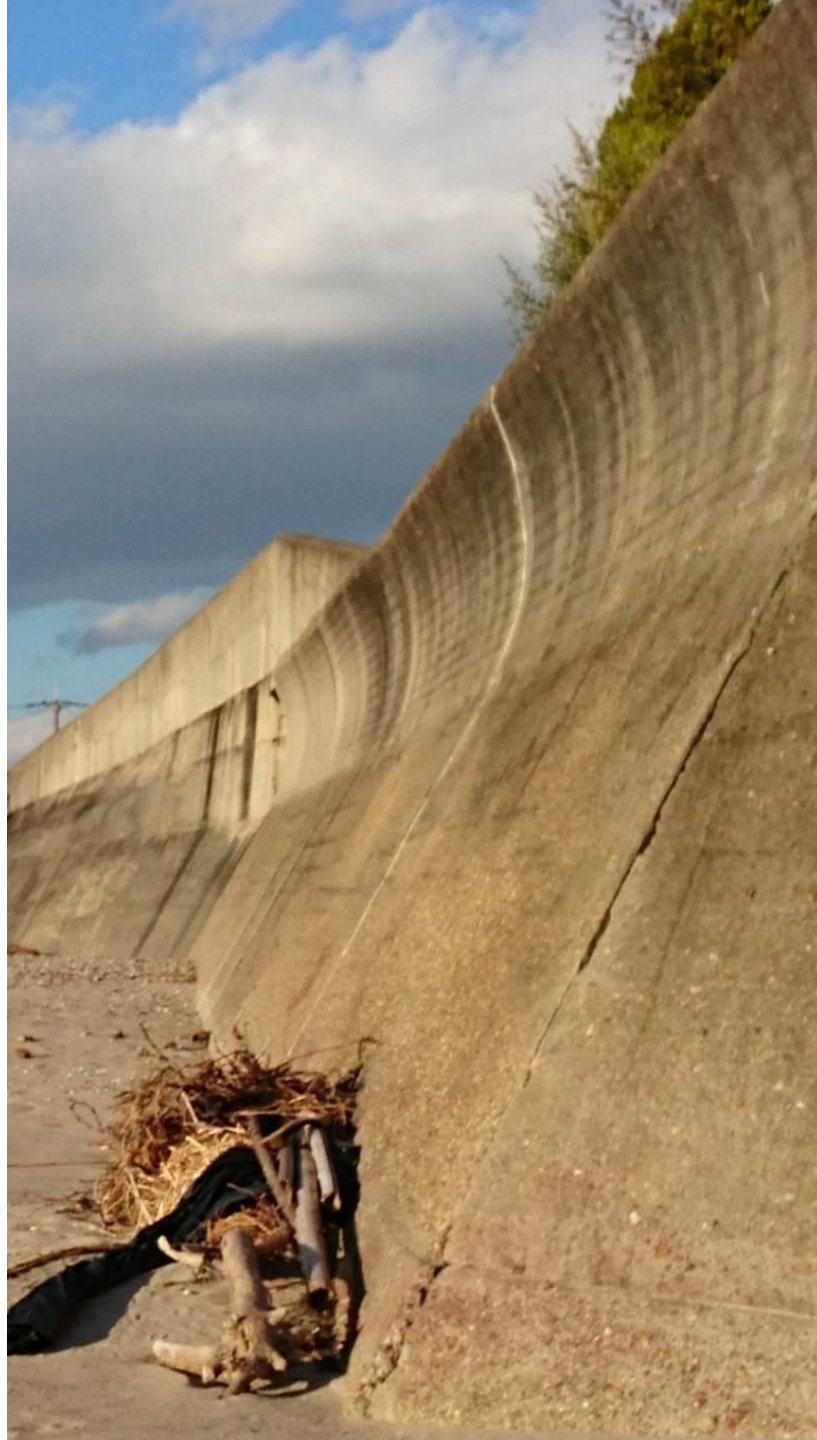


The wave height Xm	The wave height Xm
20m	27m
24m	32m
31m	33m

Current seawalls

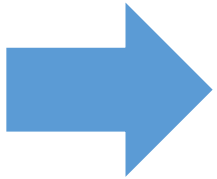
- Hard
- Block the waves
- Weaken the waves

Change the shape of seawalls



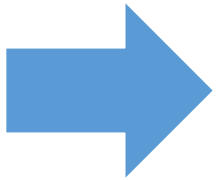
Aim

1.Protect places people escape to



Control the direction

2.Buy time to escape



Slow down the speed

Contents

Keyword

- Size
- Wave speed,
  Volumes of flow

} Similarity between reality and model

Consider fluid mechanics

F_r : Fluid number　m : mass　a : acceleration

g : gravitational acceleration　V : velocity　L : length

A : reality　B : model　h : depth of water

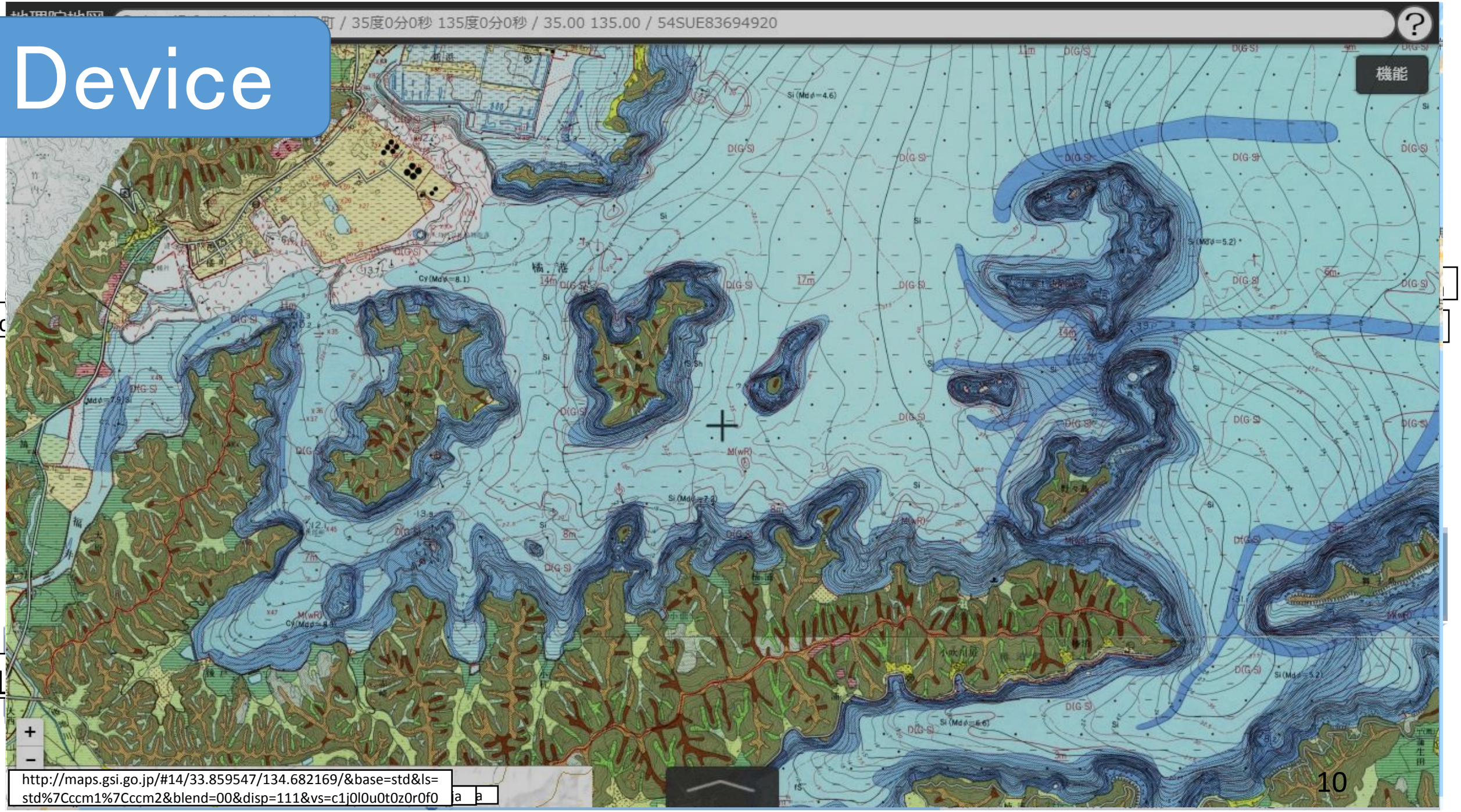
$$F_{rA} = F_{rB}$$

Fluid number : $F_r = \dfrac{ma}{mg} = \dfrac{V}{\sqrt{Lg}}$

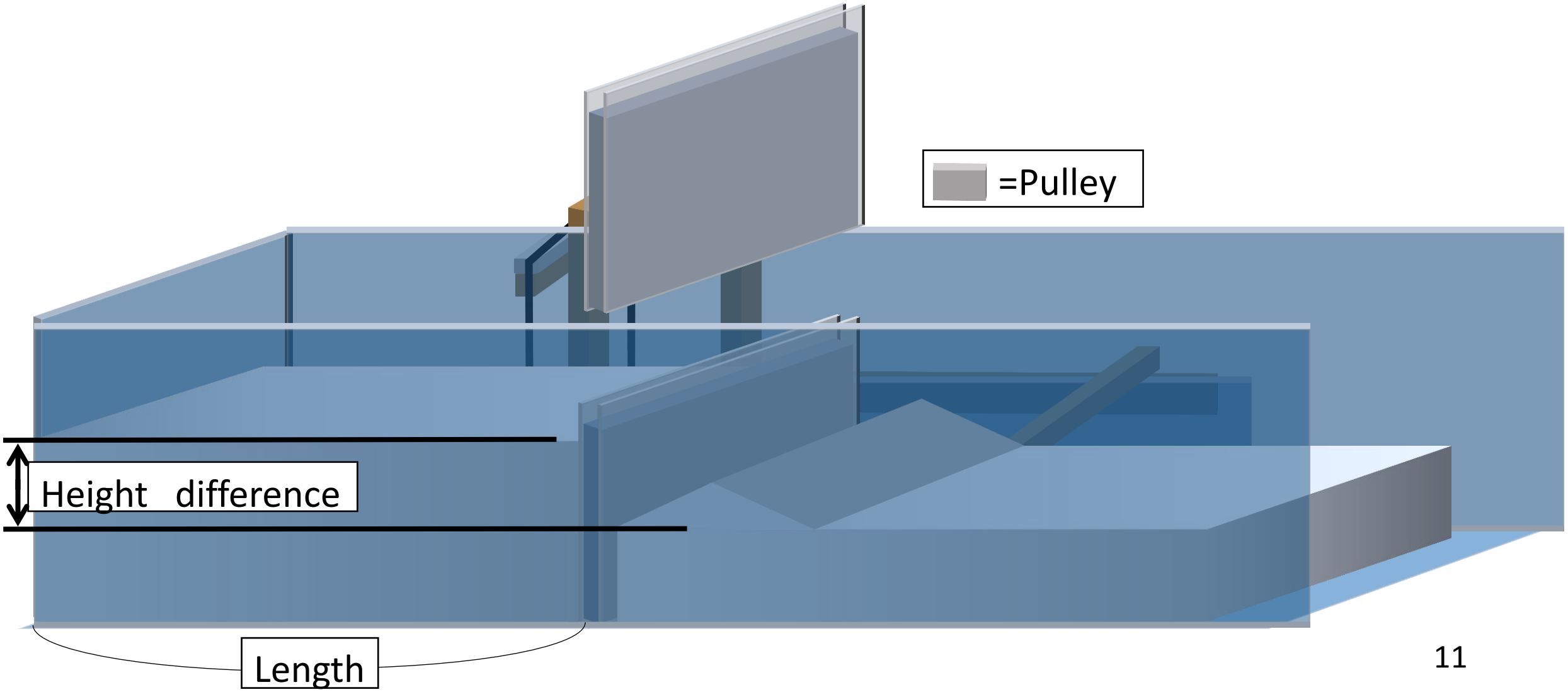
$$V_B = \sqrt{gh_B}$$

Contents

Device

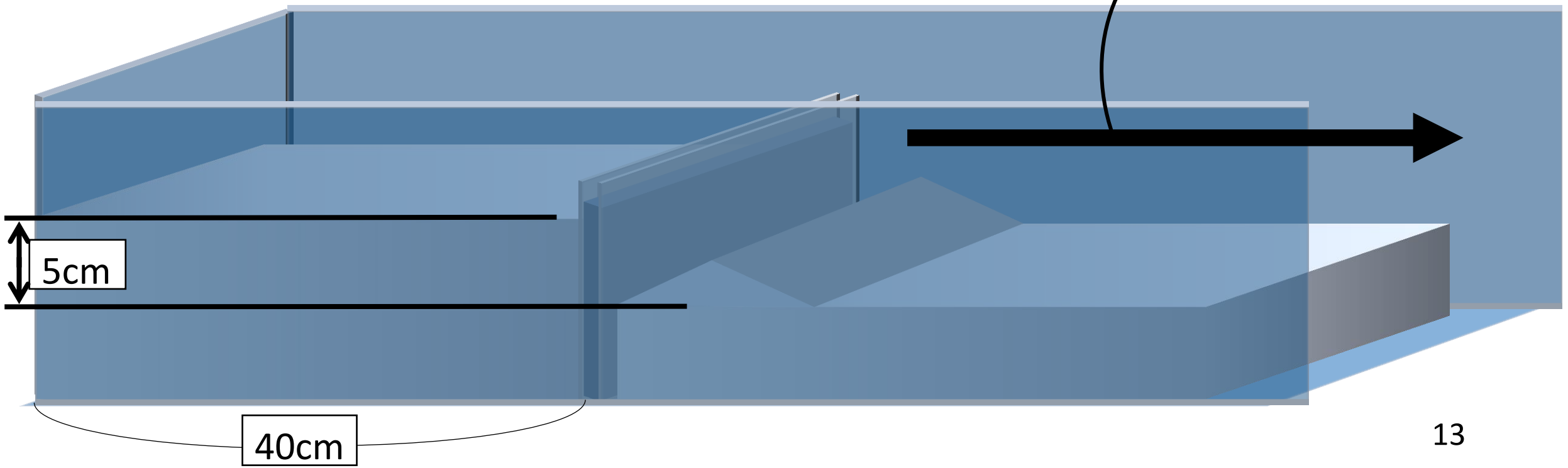

35度0分0秒 135度0分0秒 / 35.00 135.00 / 54SUE83694920
機能
http://maps.gsi.go.jp/#14/33.859547/134.682169/&base=std&ls=std%7Cccm1%7Cccm2&blend=00&disp=111&vs=c1j0l0u0t0z0r0f0

Device



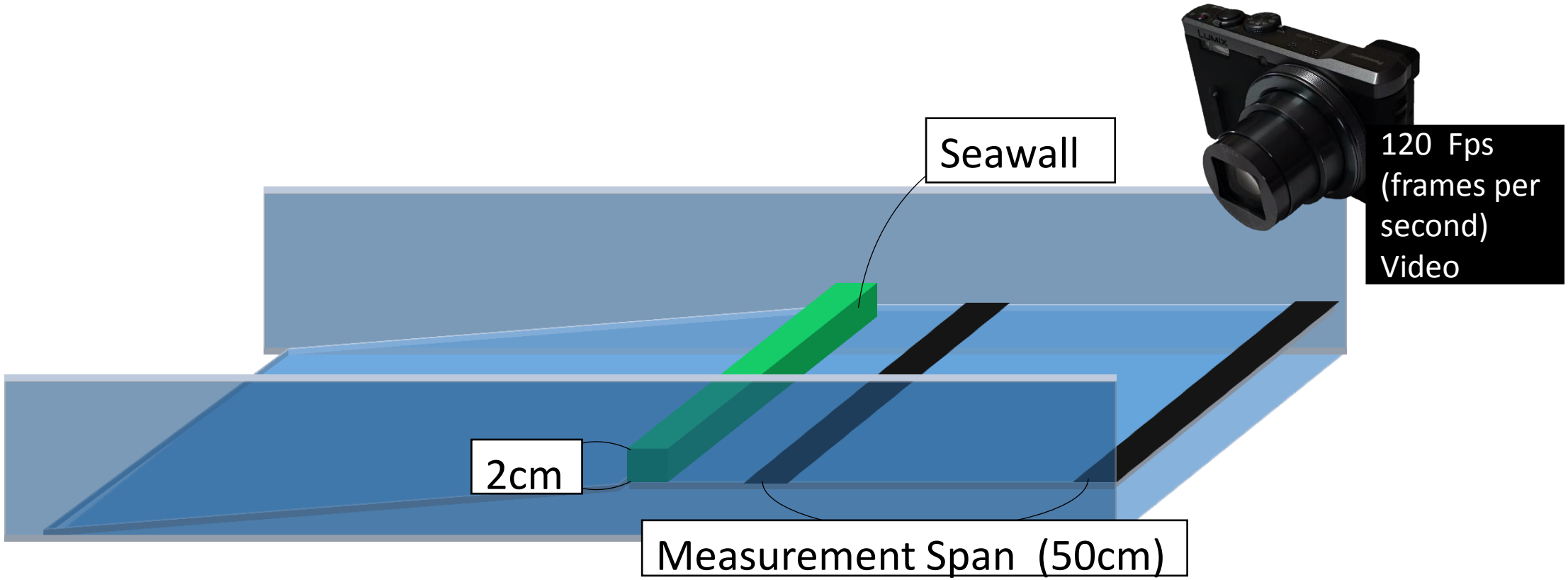
Device

$$V_B \fallingdotseq 0.828\,m/s \quad \fallingdotseq \quad 0.8421 m/s$$

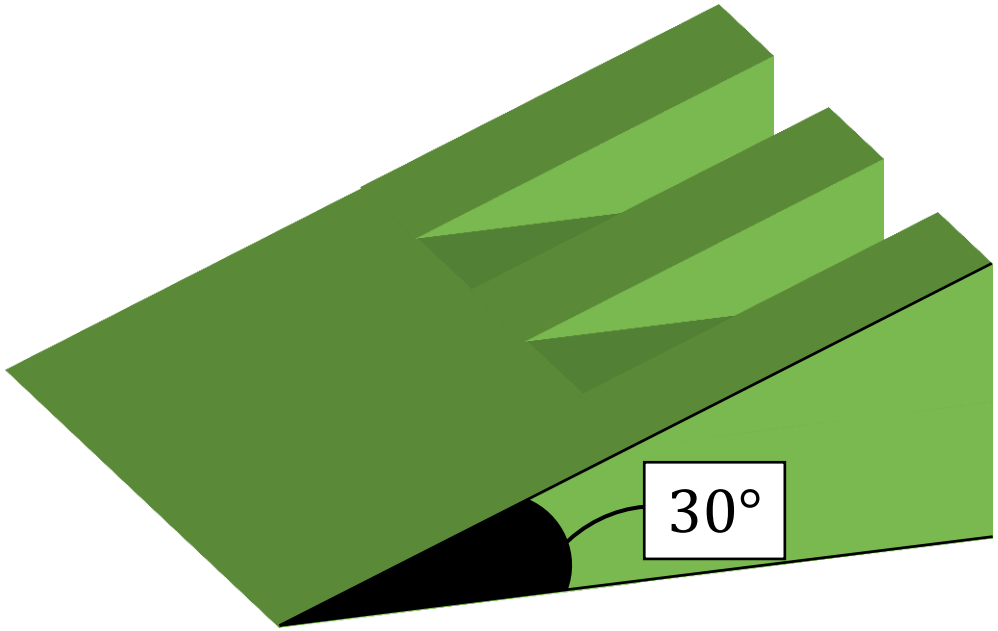


Content

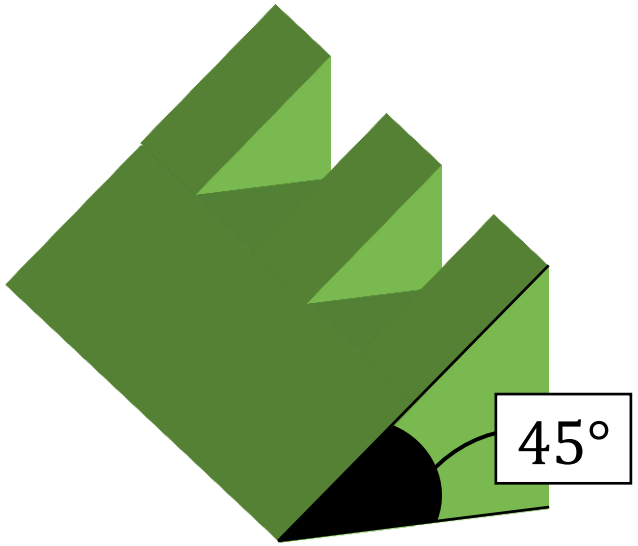
Measurement Method



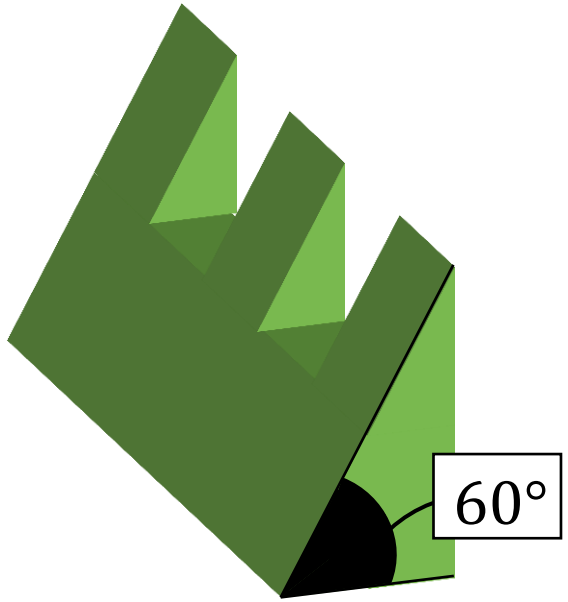
Seawall



Slit30°



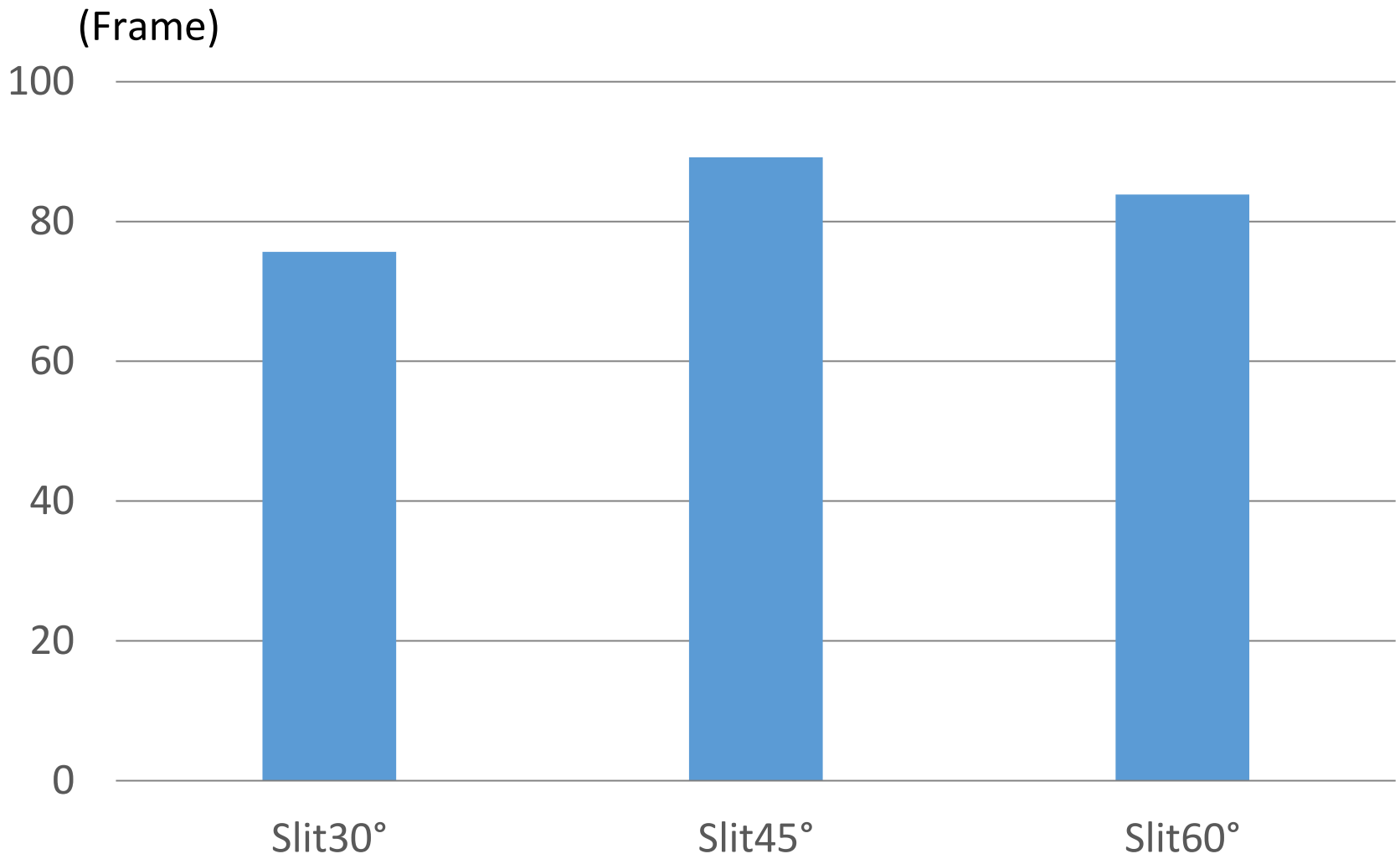
Slit45°



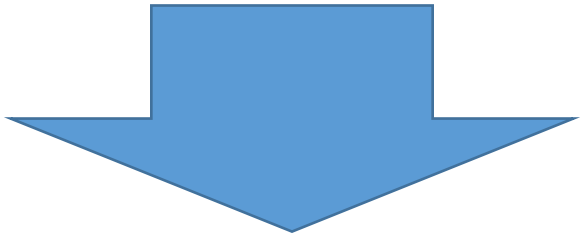
Slit60°

Result 1

Type Slit

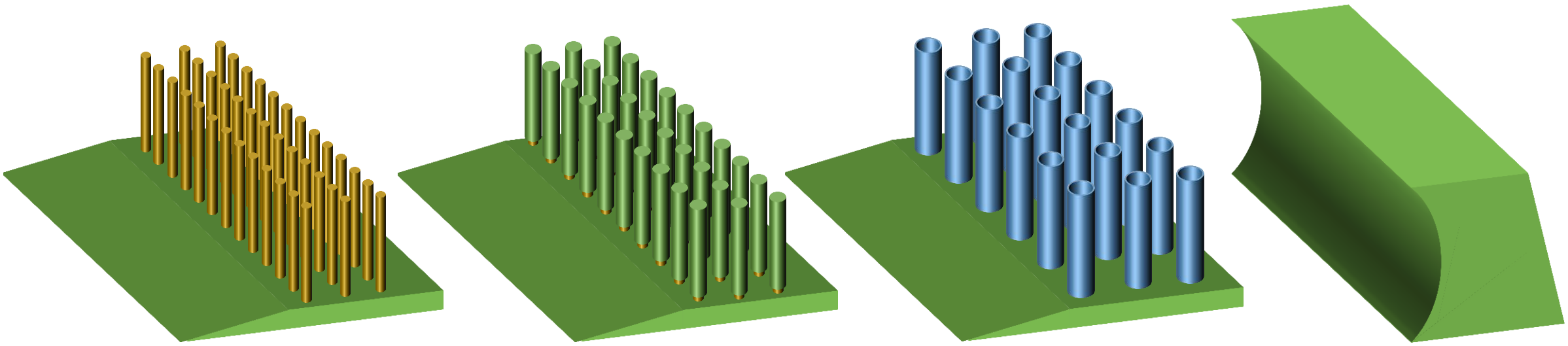


Control and set obstacles on the focus points



Control the waves and improve the wave-weakening effect

Seawall



Stick Brown

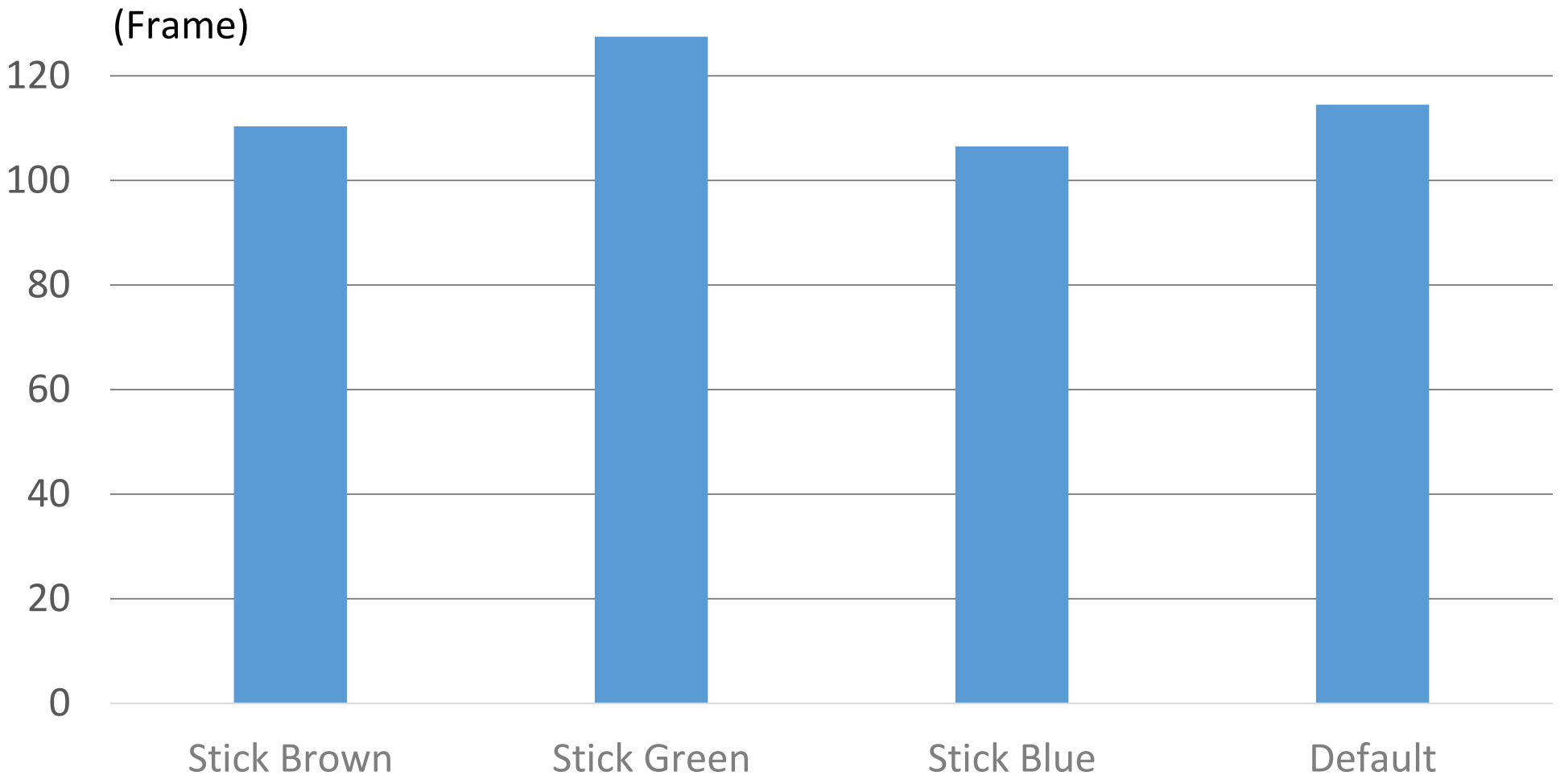
Stick Green

Stick Blue

Default

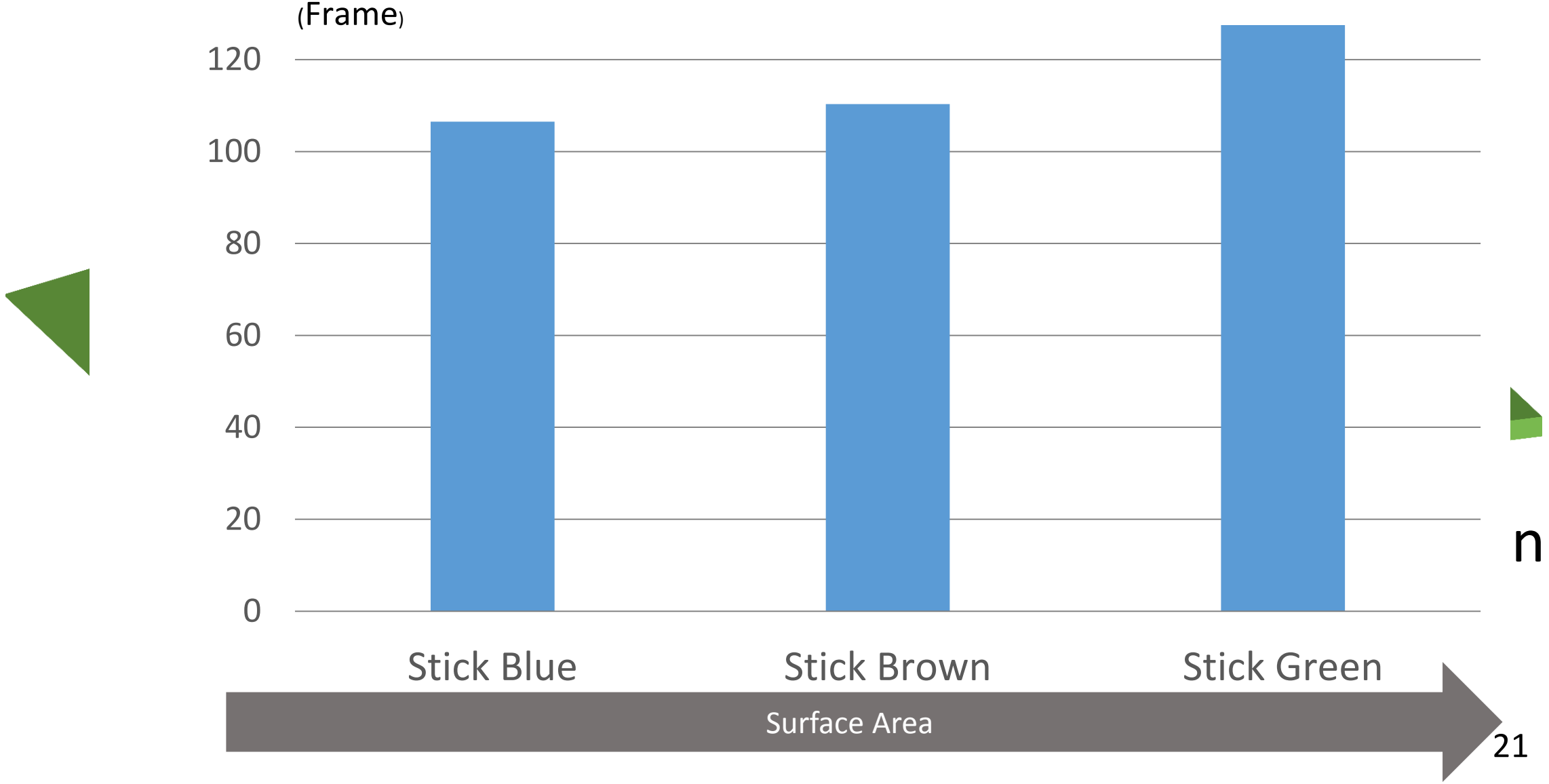
Result 2

Type Stick & Default



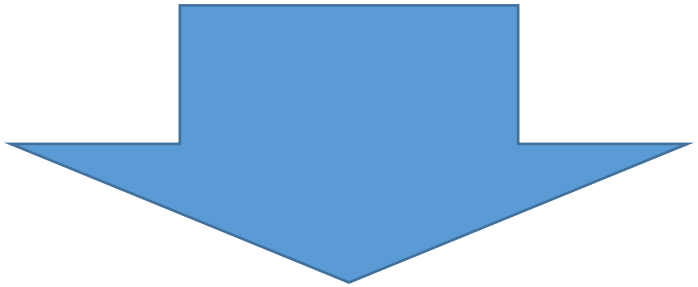
Analysis

After Rearranged



Change width

Change density



Reduce wave speed further

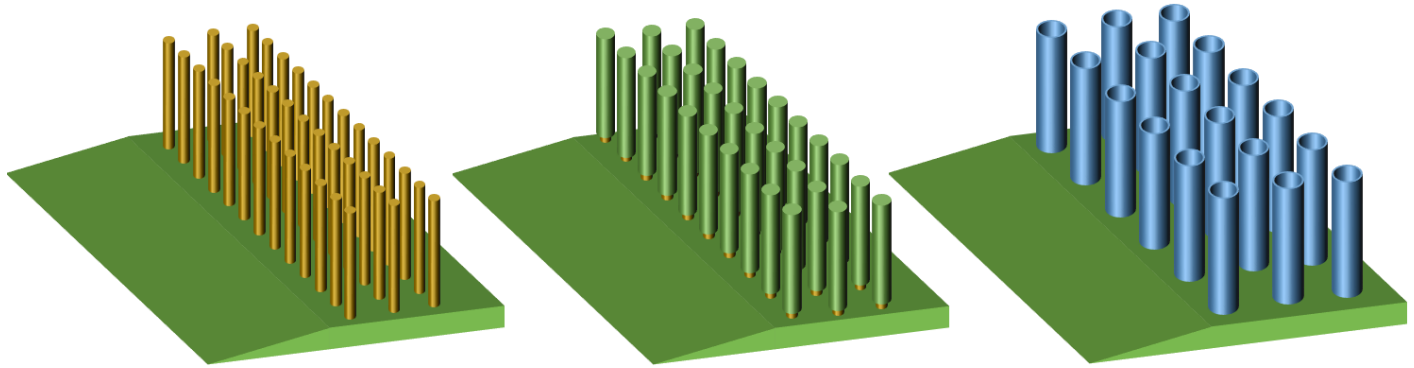
Contents

Summary

Slit types separated wave.

→ Protect places people escape to

Summary



The stick types have potential to reduce wave speed.

→ Buy time to escape

Contents

Future research

- To change the angle of the slits,
- Prevention of focus points
- Changing the density of sticks
- Making a seawall using both the types of seawalls

References

- Suzuki hiro, Nagashima Akira, “Under High Pressure Viscosity Coefficient of Seawater,” in Transactions of the JSME (in Japanese), 46,408(1980), pp.1574-1582,1980.
- National Institutes of Natural Sciences, *Chronological Scientific Tables*, Japan, Maruzen, 1995.
- Hirasaki Tetsuya, Mori Nobuhito, Yasuda Tomohiro, Azuma Ryokei, and Mase Hajime, *Characteristics of Tsunami Generator Newly Implemented in Disaster Prevention Research Institute, Kyoto University*, Japan, 2015.
- Tsubaki Touitirou, Araki Masao, *Exercise in Hydraulics(Volume One),* Japan, Morikitasyuppan, 1961.


Thank you for your time and attention!

Wave Velocity

Length / Lift	20cm	30cm	40cm
3cm	0.738461538m/s	0.751284869m/s	0.801165846m/s
4cm	0.761904762m/s	0.786885246m/s	0.817586207m/s
5cm	0.787393436m/s	0.807235726m/s	0.832105263m/s
6cm	0.800593252m/s	0.83710475m/s	0.856507852m/s

Complement

F_r : fluid number m : mass L : length ρ : density
g : gravitation acceleration V : velocity a : acceleration

$$\frac{ma}{mg} = \frac{\rho L^3 \dfrac{V}{L/V}}{\rho L^3 g} = \frac{\rho L^2 V^2}{\rho L^3 g} = \frac{V^2}{Lg}$$

$$F_r = \frac{V}{\sqrt{Lg}}$$

F_r : Fluid number m : mass a : acceleration

g : gravitational acceleration V : velocity L : length

A : reality B : model h : depth of water

$$F_{rA} = F_{rB} \Rightarrow \frac{V_B}{V_A} = \sqrt{\lambda}$$

Formula of wave speed : $$V_A = \sqrt{gh_A}$$

F_r : Fluid number　m : mass　a : acceleration

g : gravitational acceleration　V : velocity　L : length

A : reality　B : model　h : depth of water

$$V_B = \sqrt{\lambda g h_A} = \sqrt{\lambda g \frac{h_B}{\lambda}} = \sqrt{g h_B}$$

H wave height on shore	H_0 wave height in the offing
b width on shore	b_0 width in the offing
h water depth on the shore	h_0 water depth in the offshore area

Green's law

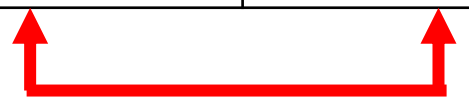
$$\frac{\mathrm{H}}{\mathrm{H}_0} = \left(\frac{b_0}{b}\right)^{\frac{1}{2}} \left(\frac{h_0}{h}\right)^{\frac{1}{4}}$$

Bigger Bigger Bigger

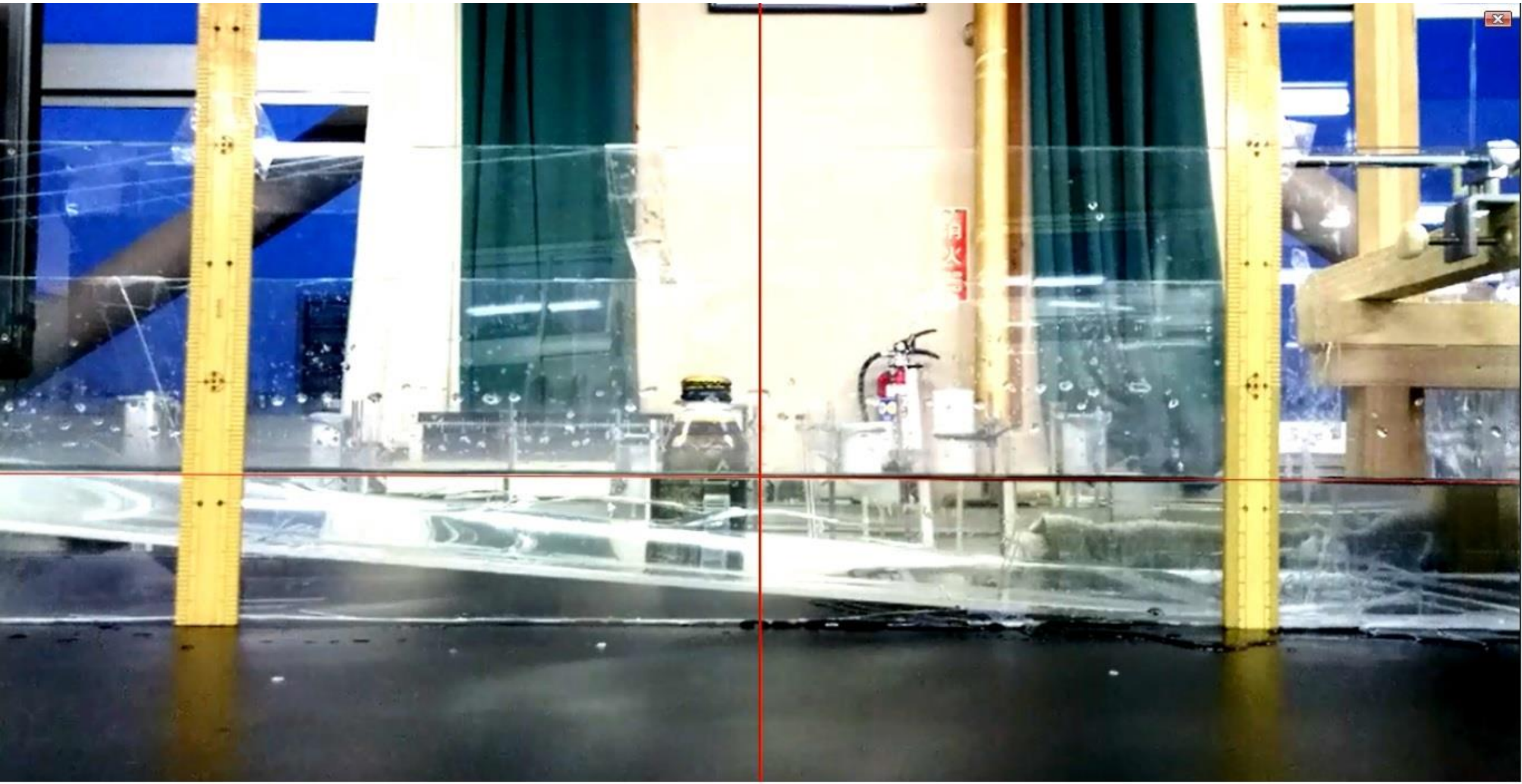
Viscosity: of spreading force

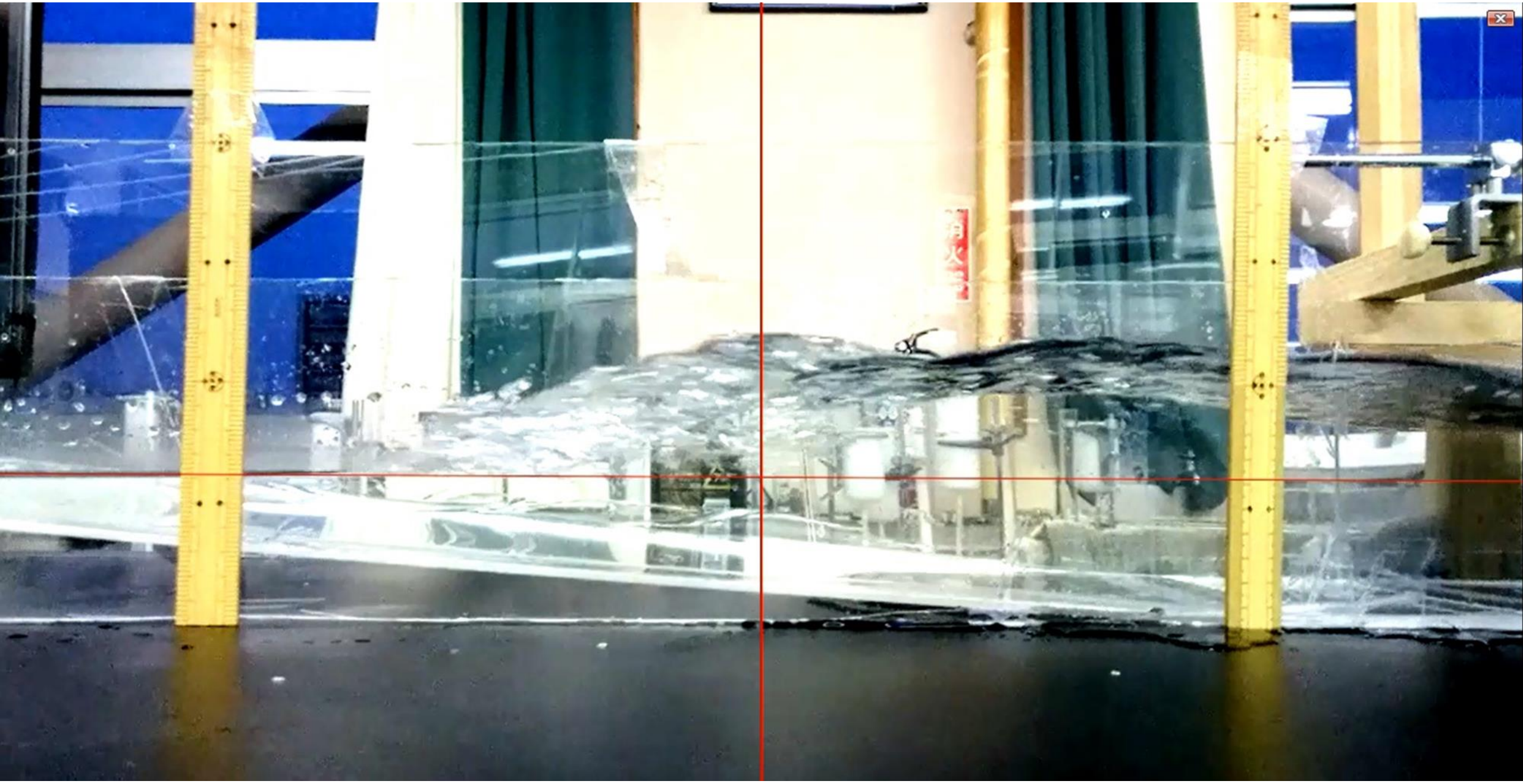
Kinematic viscosity: of spreading speed

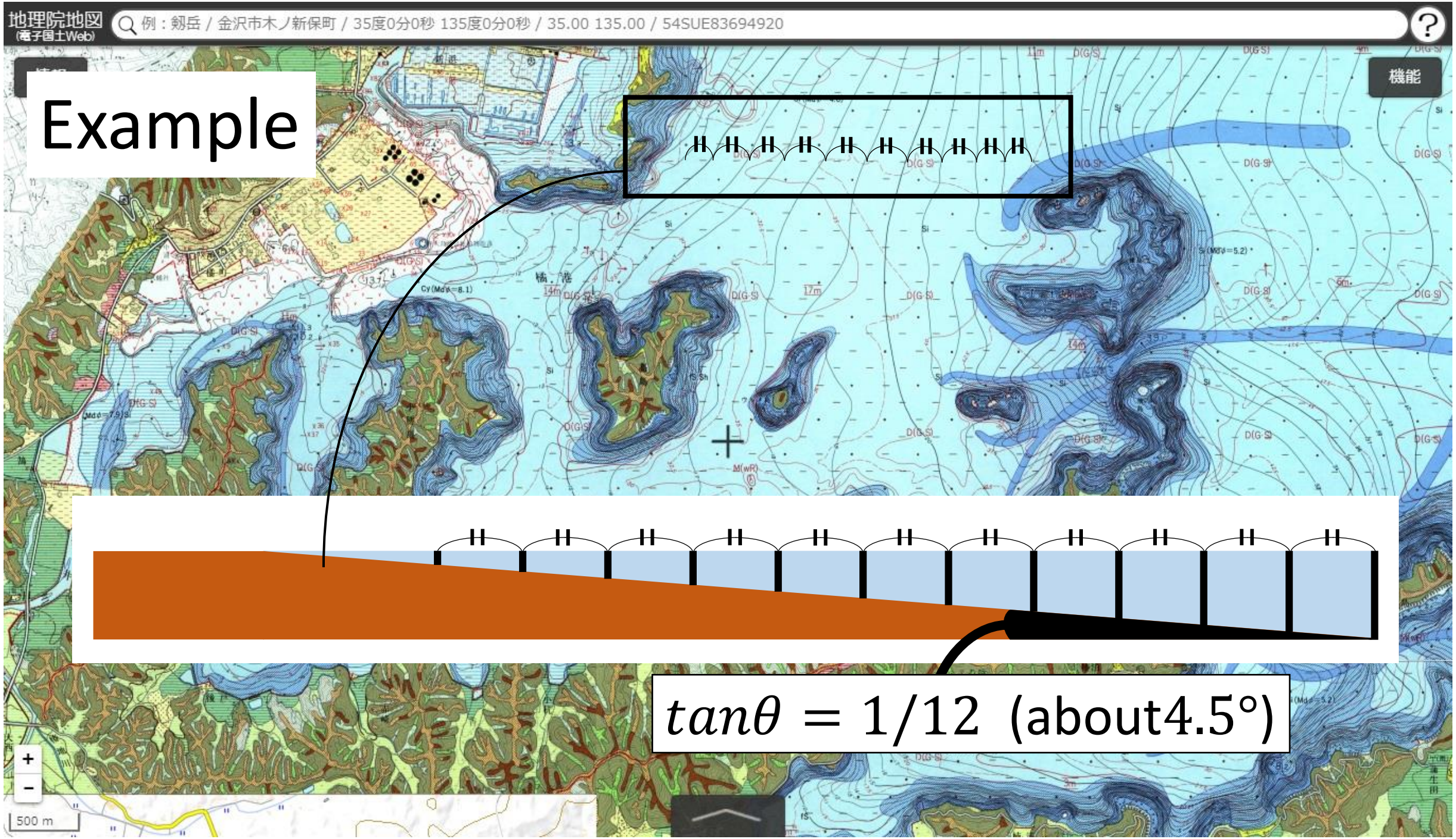
	Pure water	Seawater	Castor oil
Viscosity（Pa・s）	1.002×10^{-3}	1.075×10^{-3}	700
Kinematic viscosity(m^2/s)	1.004×10^{-6}	1.049×10^{-6}	0.723

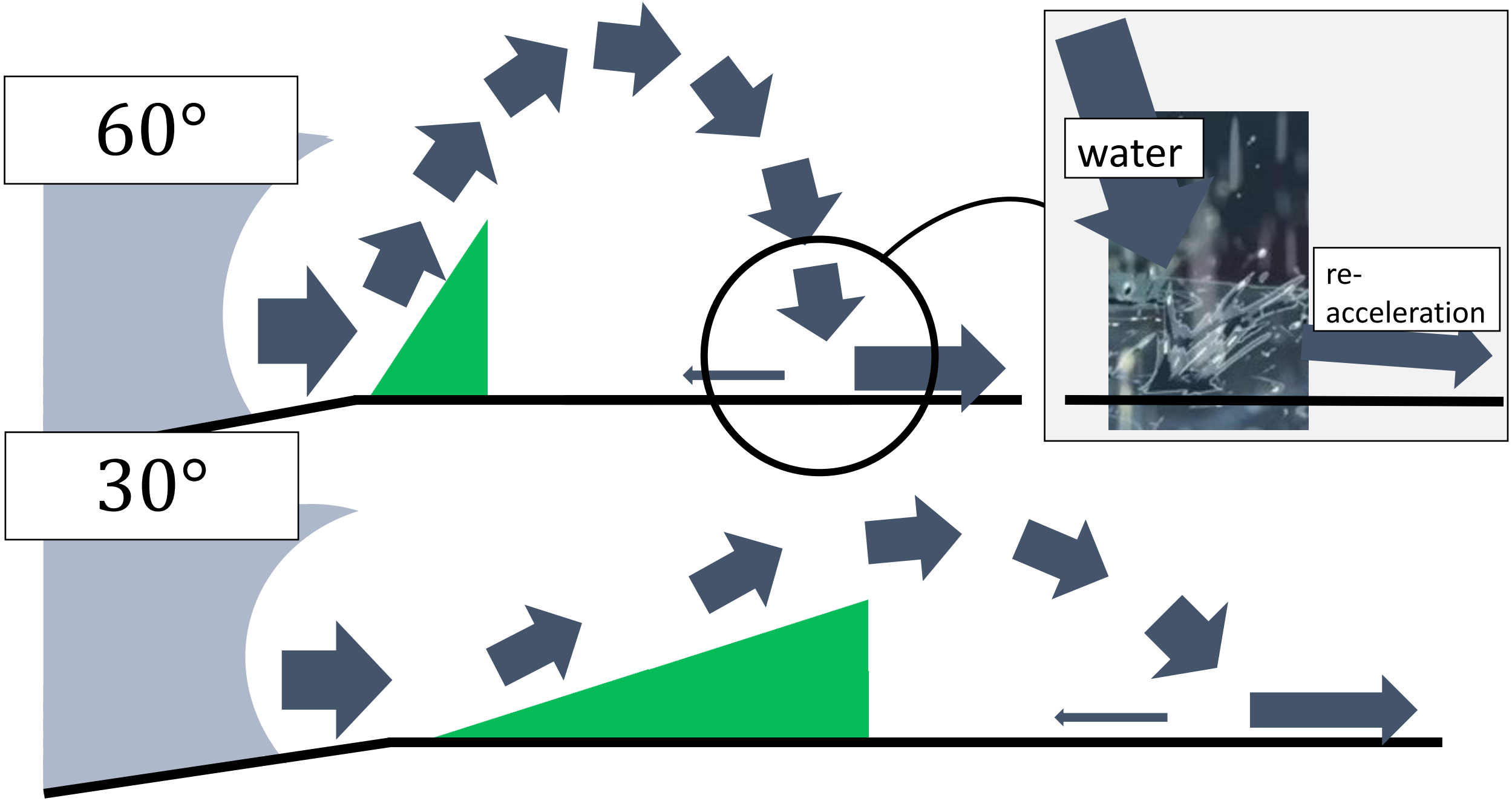


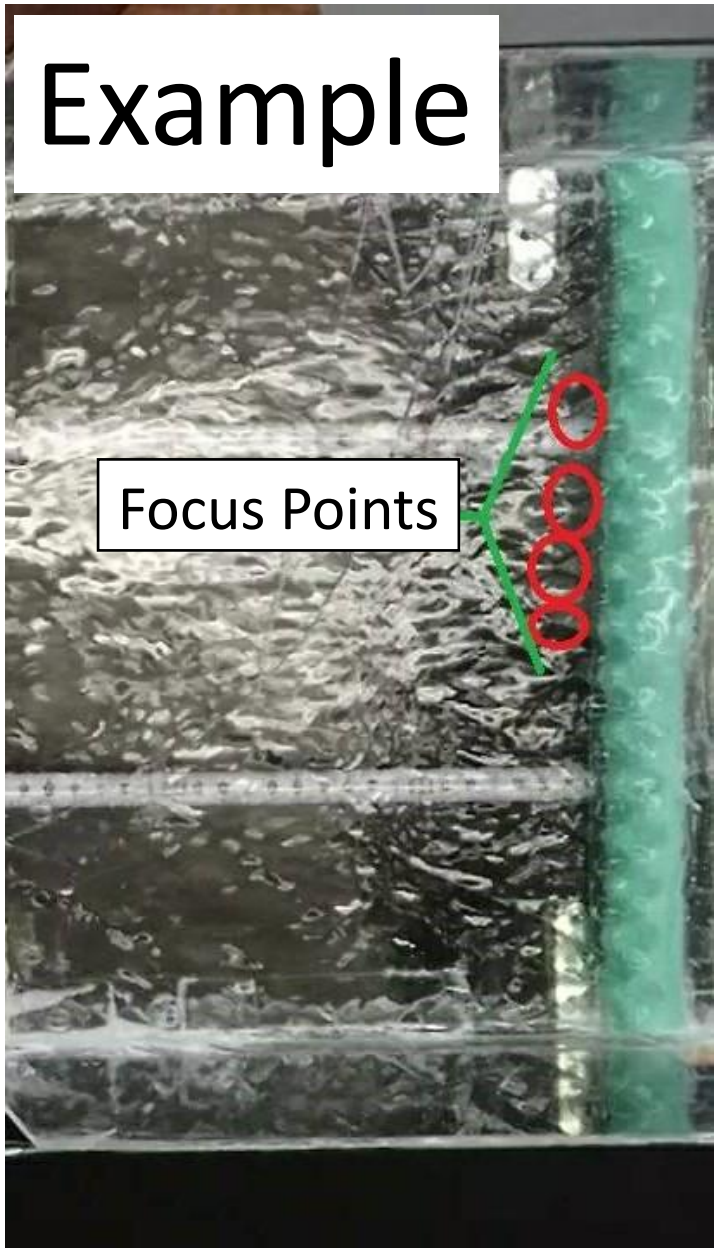
Very small

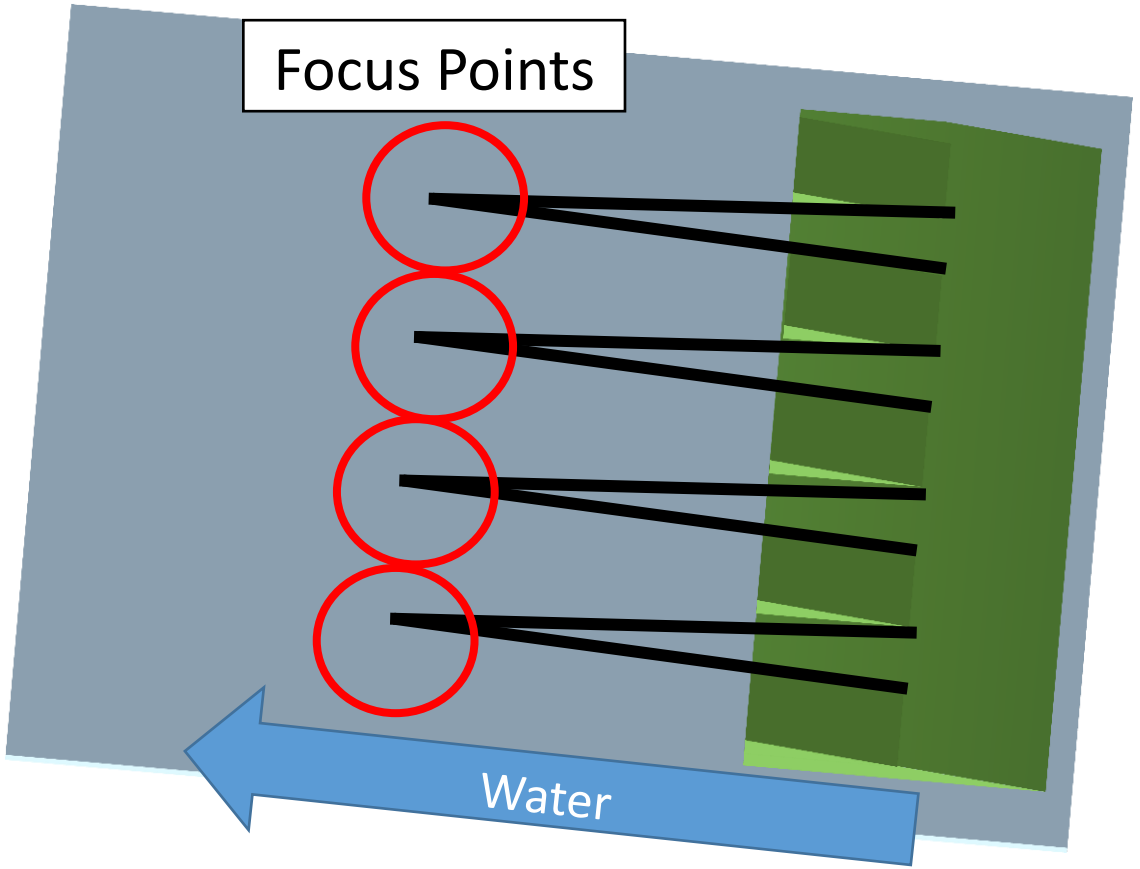





地理院地図
(電子国土Web)
例：剱岳 / 金沢市木ノ新保町 / 35度0分0秒 135度0分0秒 / 35.00 135.00 / 54SUE83694920
機能
Example
$tan\theta = 1/12$ (about4.5°)
500 m

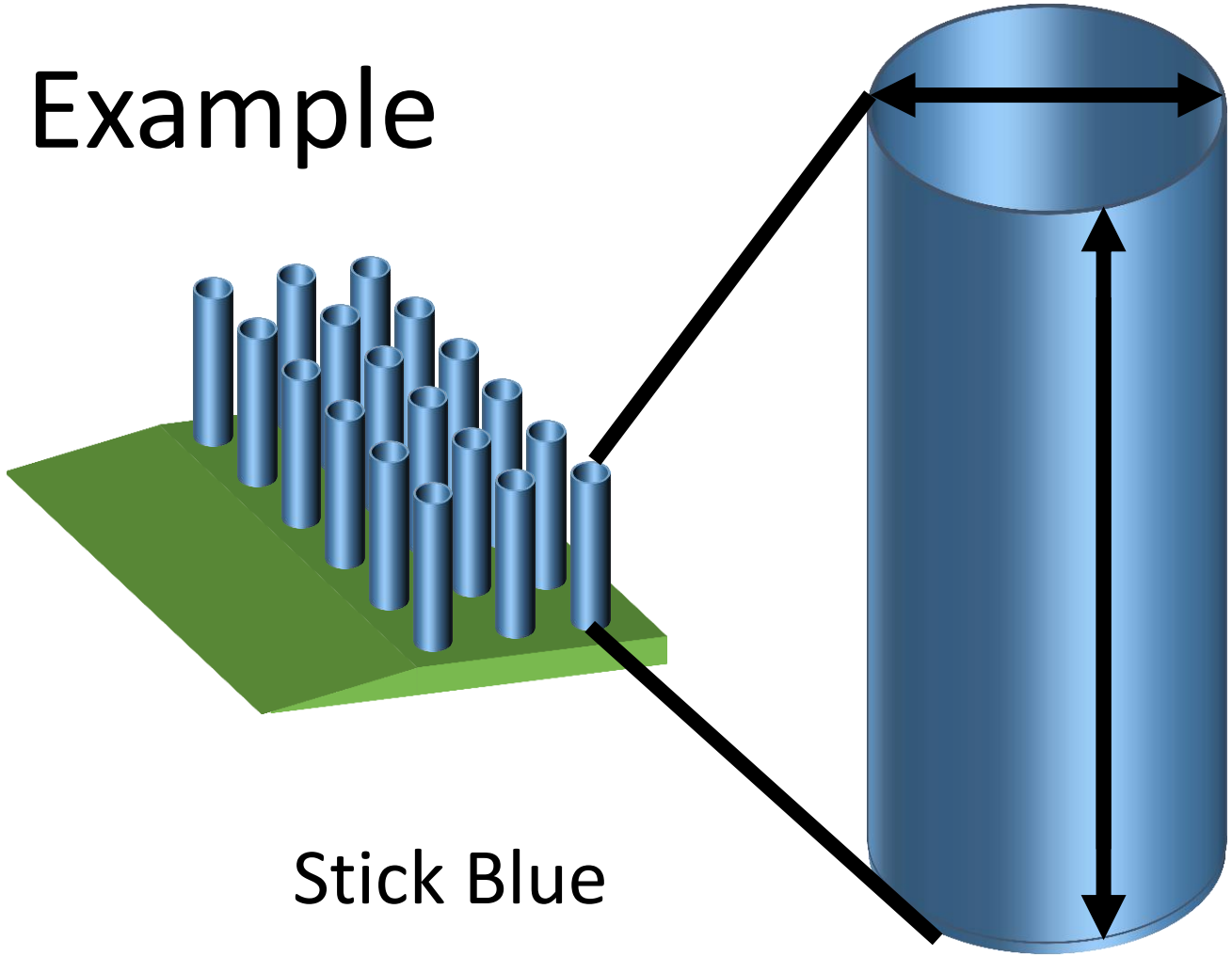

60°
30°
water
re-
acceleration


Example
Focus Points


Focus Points
Water

How to measure the surface area

Example



Stick Blue

Radius $\times 2 \times \pi \times$ Height

$=$ Surface of Cylinder

$\times$

Number of Stick

Surface Area