INTERNATIONAL SEMINAR ON APPLICATION OF
ADVANCED TECHNOLOGY IN SLOPE ENGINEERING

7th Jan, 2025

The Latest Technical Information on Mechanically Stabilized Earth Wall in Japan

~ Countermeasure study for heavy rain disasters ~

HIROSE HOKYODO

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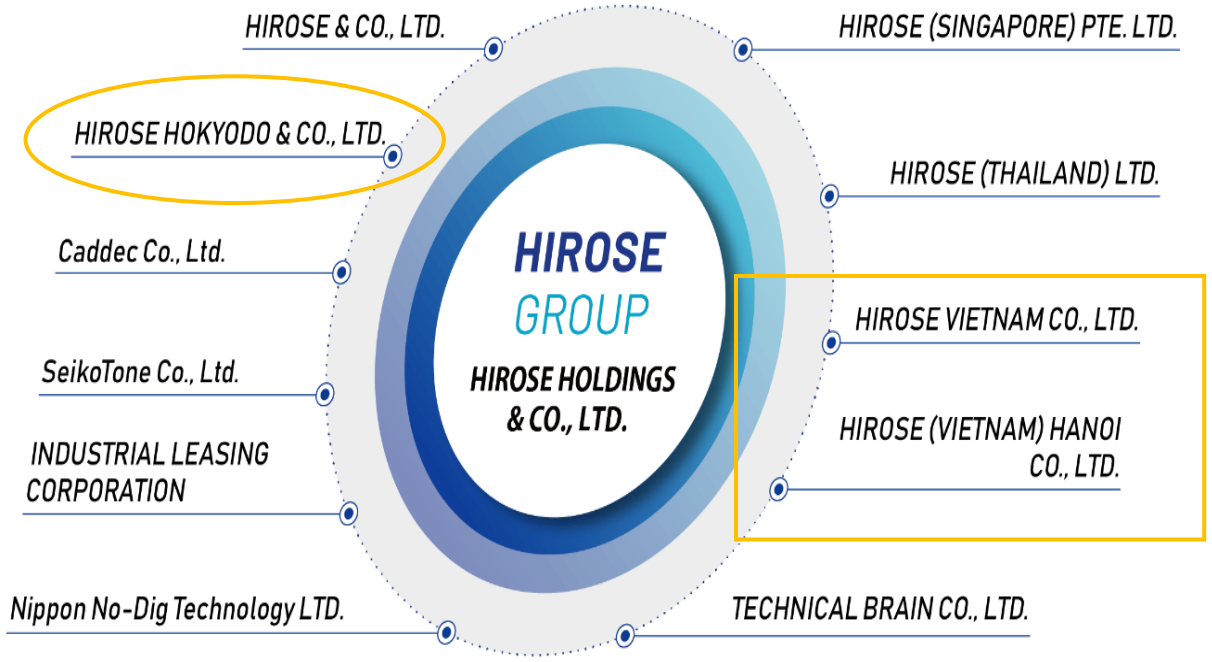
Introduction to the HIROSE GROUP

HIROSE GROUP Philosophy

We continue to support a prosperous society through high-quality, reliable technology and on-site capabilities developed over decades.

+ Japan domestic: 10 companies
+ Oversea: 4 companies

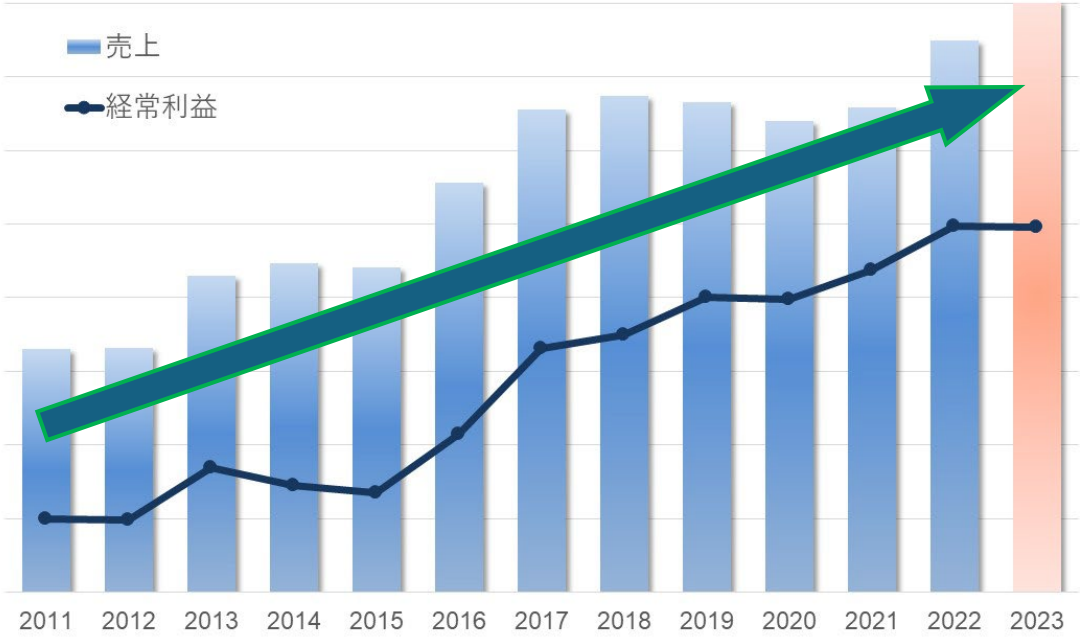


1938 - 2023
(85th Anniversary)

Annual Sales: 160 billion yen (~1B USD)

Ordinary Profit: 12 billion yen (~79M USD)

Number of Employees: ~1,800



HIROSE HOKYODO & CO., LTD.

A Specialized construction company for soil reinforcement

① Products Sales

Reinforced Soil Wall, EPS, M1 Wall, etc

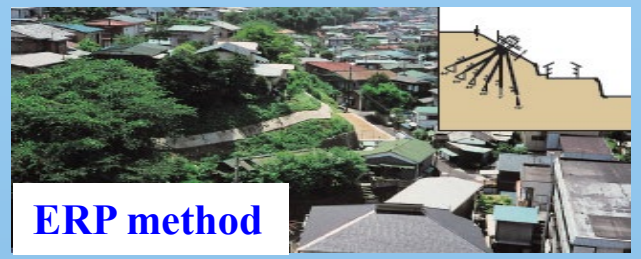
Reinforced Soil Wall

Polystyro EPS block

M1

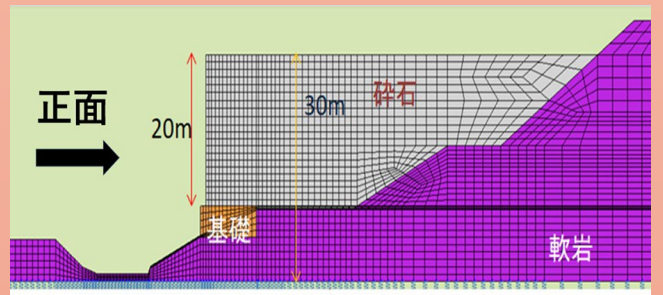
② Construction

EP Root Pile, HMP, etc

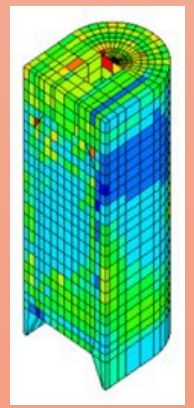


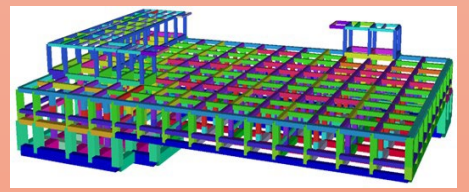
ERP method

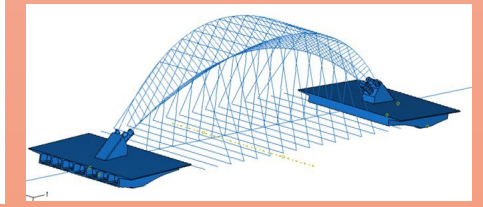
③ Analysis Services



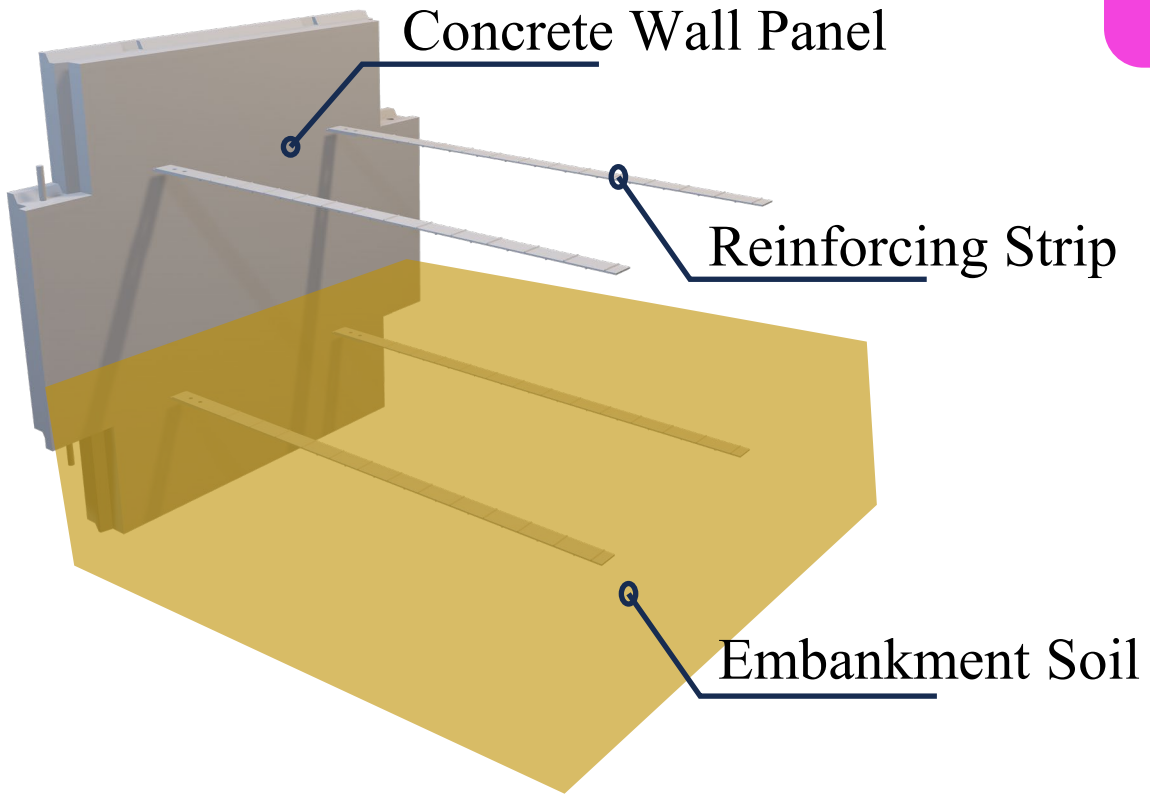
解析モデル図（横断方向）

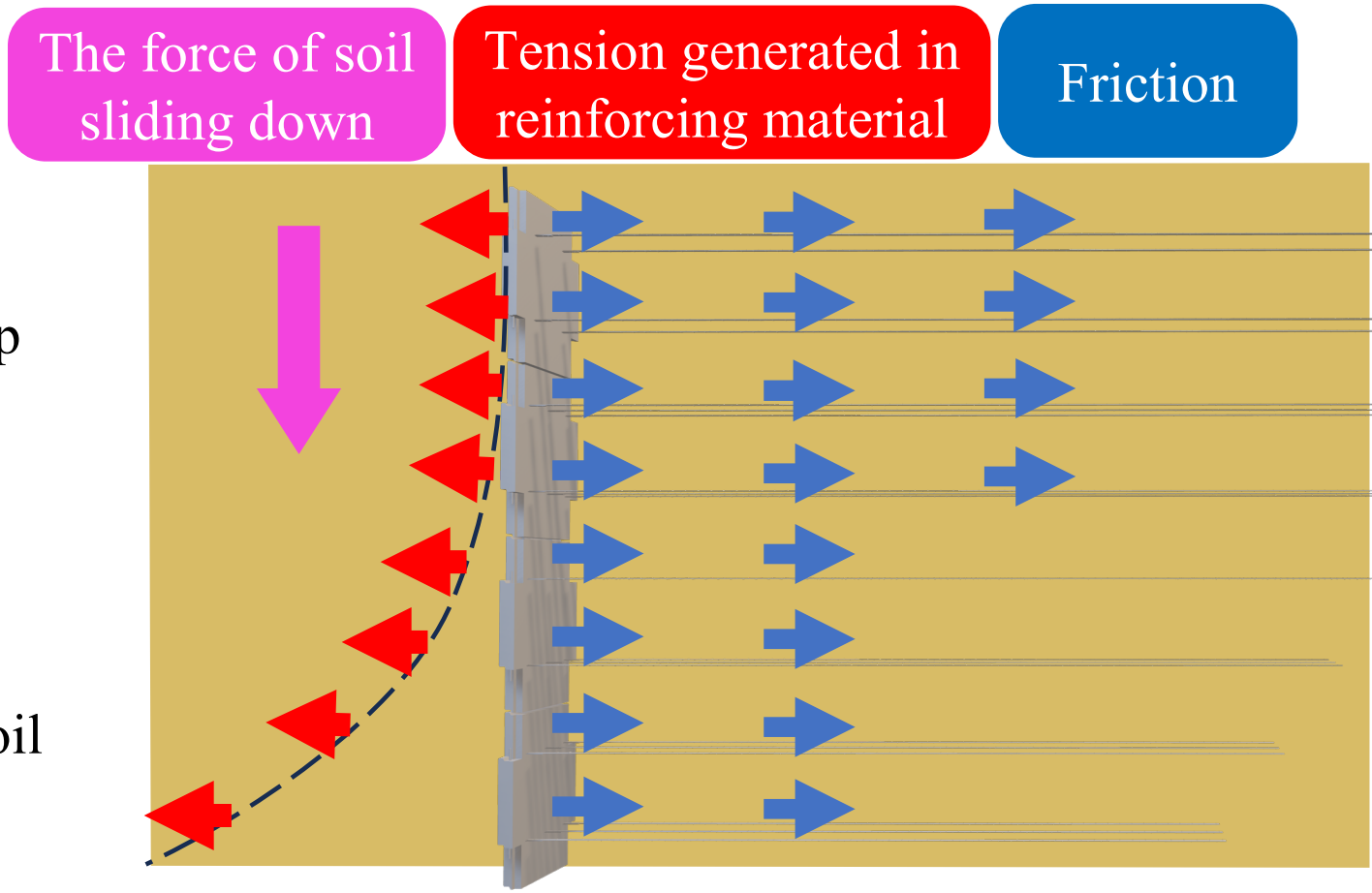






Reinforced Soil Wall Construction Method

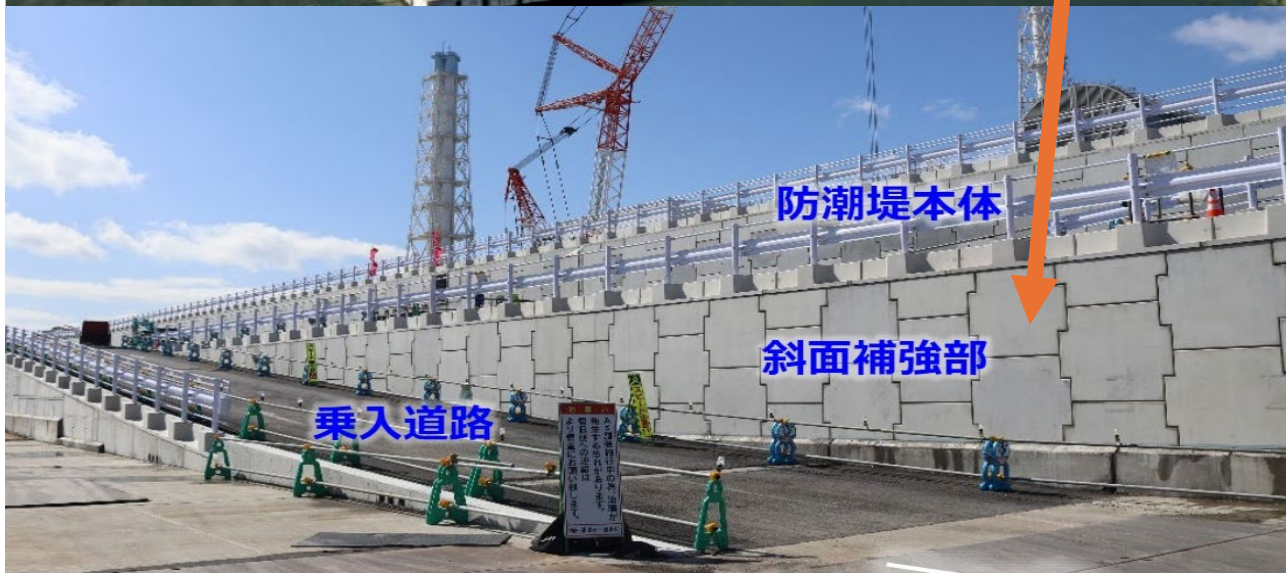




- HIROSE HOKYODO was the first to introduce method to Japan about 50 years ago.

TERRE ARMEE
Market Share No.1

Private Circuit（Chiba Prefecture）

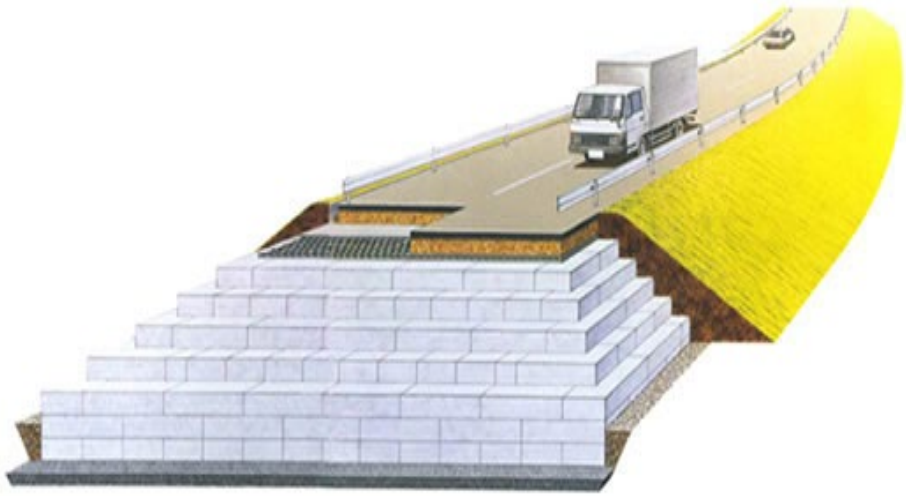


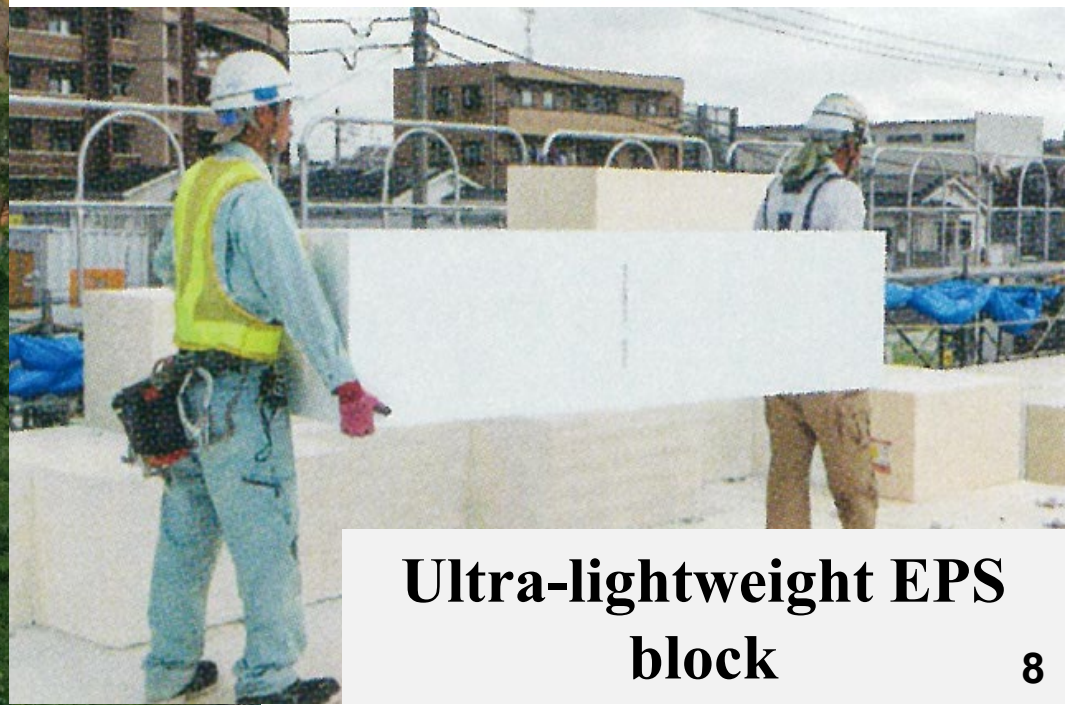
Fukushima Daiichi Nuclear Power Plant Seawall

EPS Construction method （PolyStyro Block）

EPS Market Share No.1

EPS





Ultra-lightweight EPS block

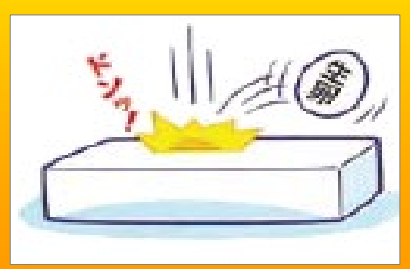
EPS Construction method（PolyStyro Block）

Ultra-lightweight (Construct easily)

Insulation (Heat is uneasily transferred)

Watertight (The foam beads are firmly fused.)

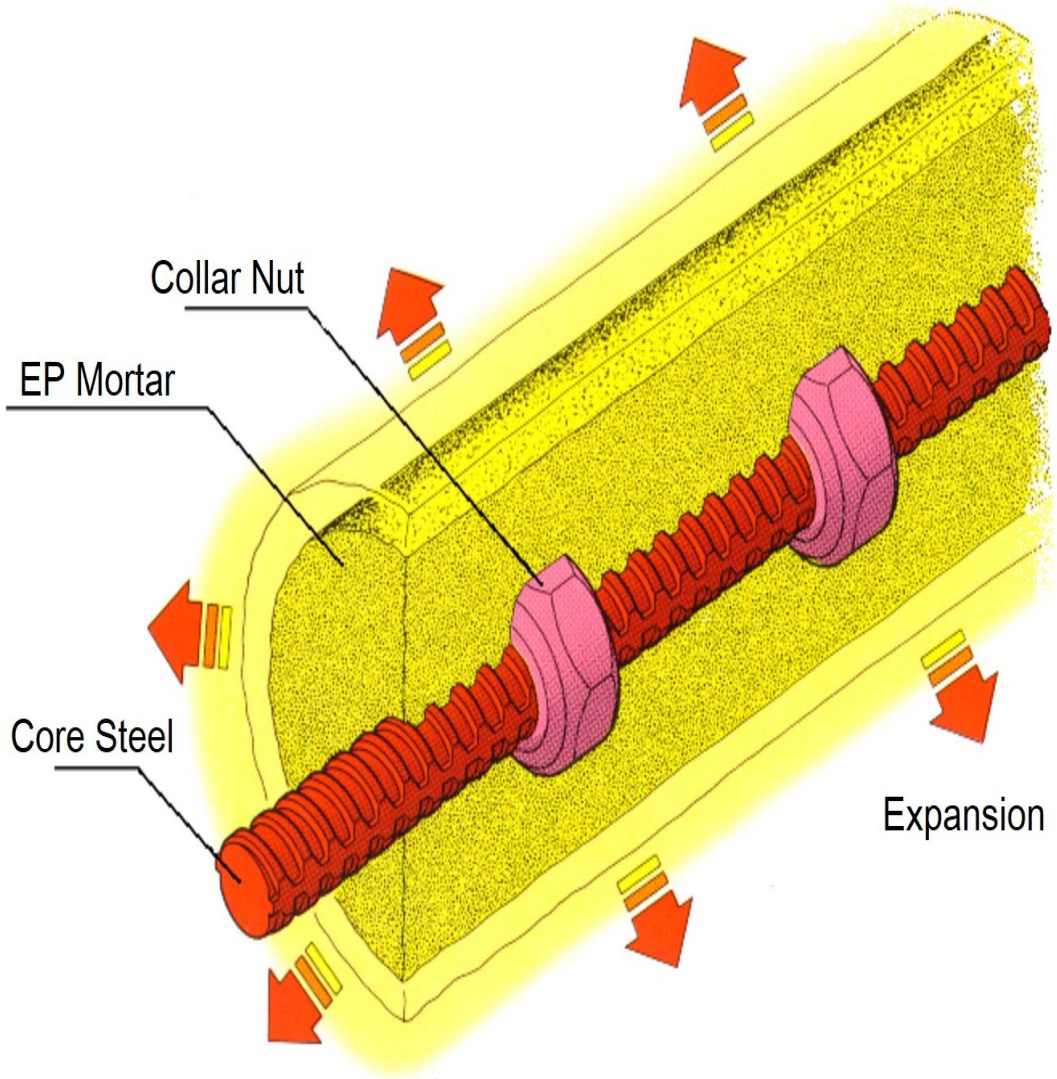
Cushioning Properties (Excellent shock absorption)

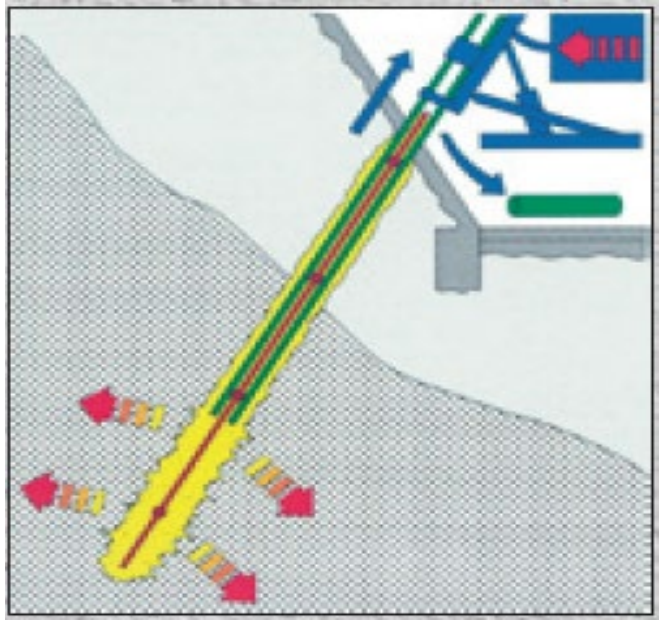


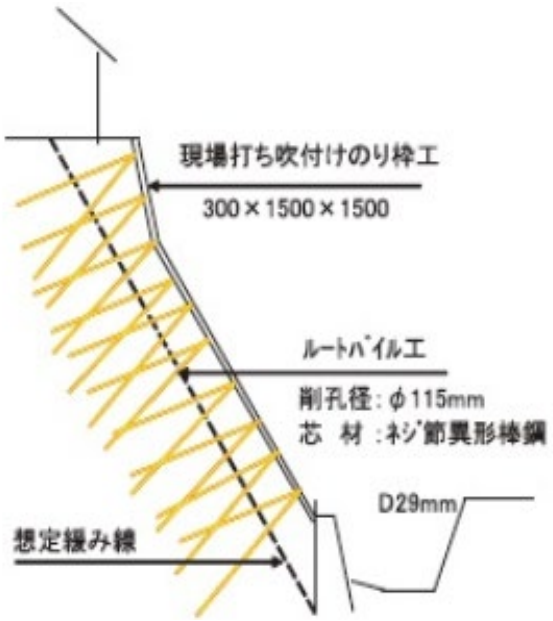
Moldability (Able to molded into various shapes)

Selectable Strength For Purpose

EXPANSION ROOT PILE (ERP) Construction Method





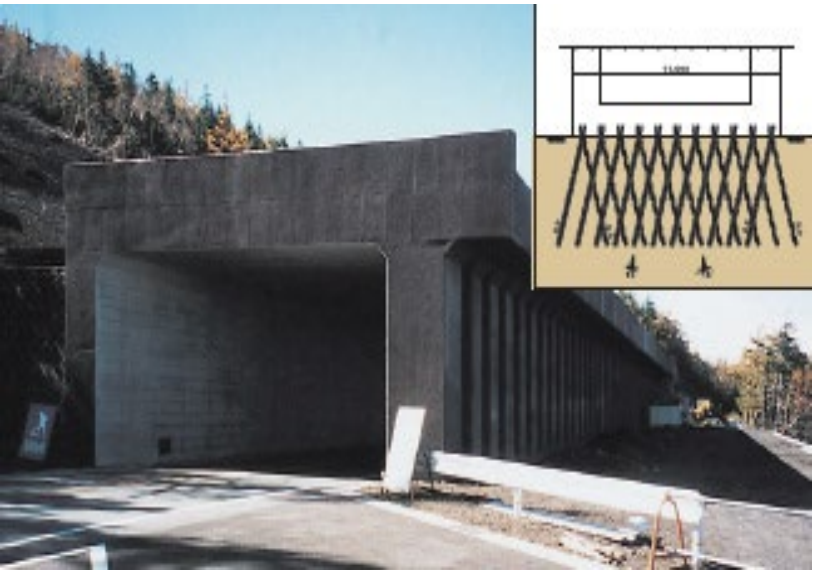


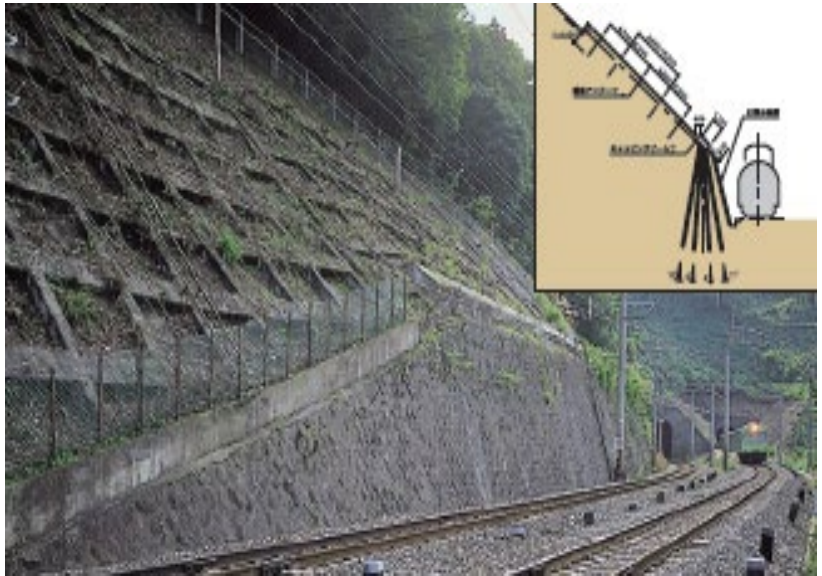
- Double-Pipe Drilling Soil Reinforcement Method (MICRO PILE ~ Drilling diameter φ115, φ135m)
- High adhesive strength from Collar nut, Expansive grout, and Pressure injection
- Able to applied to both Tensile Reinforcement and Compression Reinforcement .
- Reinforcement placing angle is 2 or more directions and applicable length 4.0m～15m or more

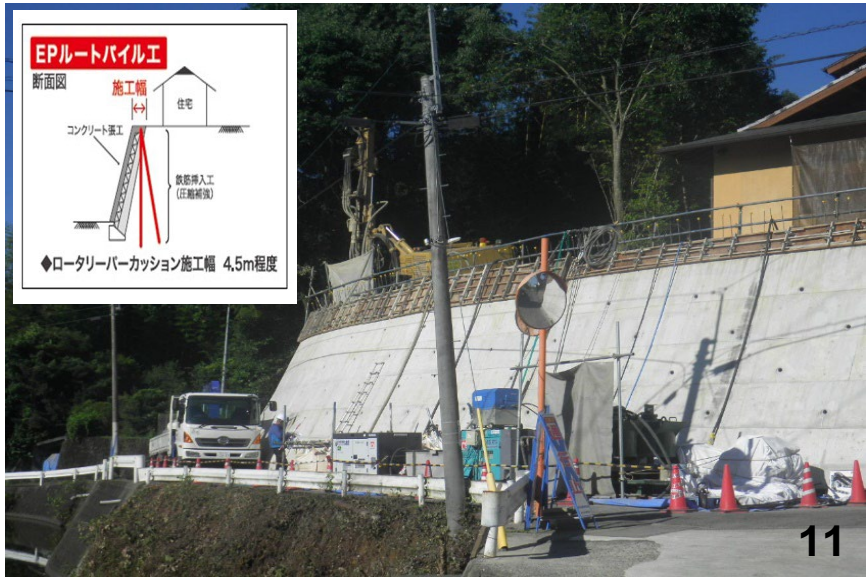
EXPANSION ROOT PILE (ERP)
Construction Method

Construction projects:
+ 2,000 or more in total
+ 100 or more annually

- Reinforcement of cut slopes
- Reinforcement of existing structures such as deteriorated retaining walls
- Ground reinforcement to eliminate insufficient bearing capacity of newly constructed retaining walls
- Countermeasures against small to medium-sized landslides



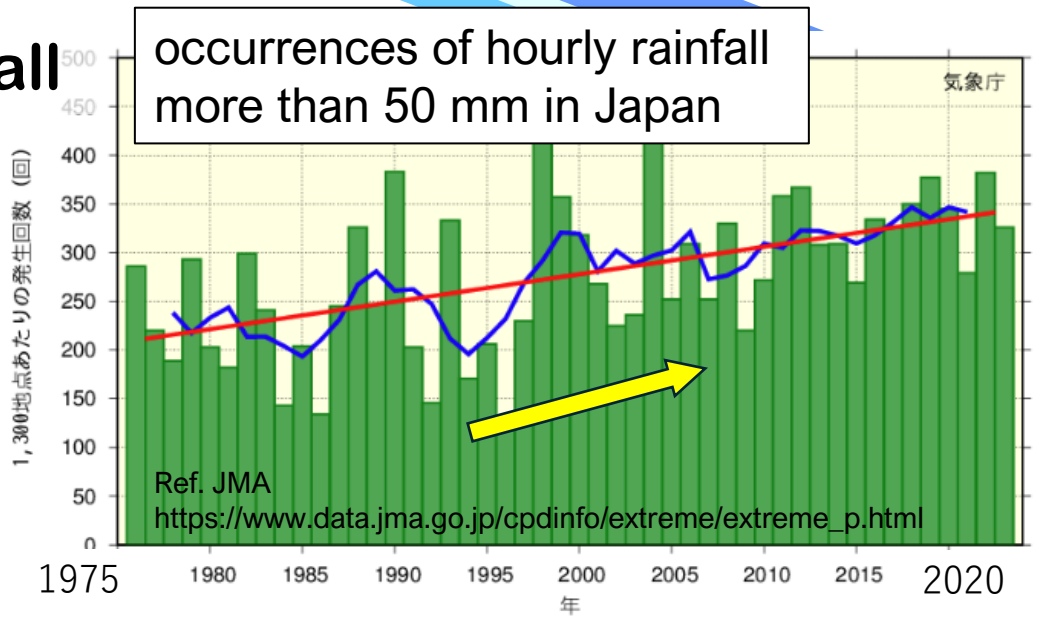




2. Countermeasure for Scouring by heavy rainfall

Background

- In recent years, Japan has experienced many heavy rainfall disasters due to climate change.
- MSE by the riverside was damaged by heavy rainfall.
- Due to the frequent disasters, there is a need to strengthen drainage specifications and measures for scouring.



Typhoon #19(2019)
24h rainfall : 925mm

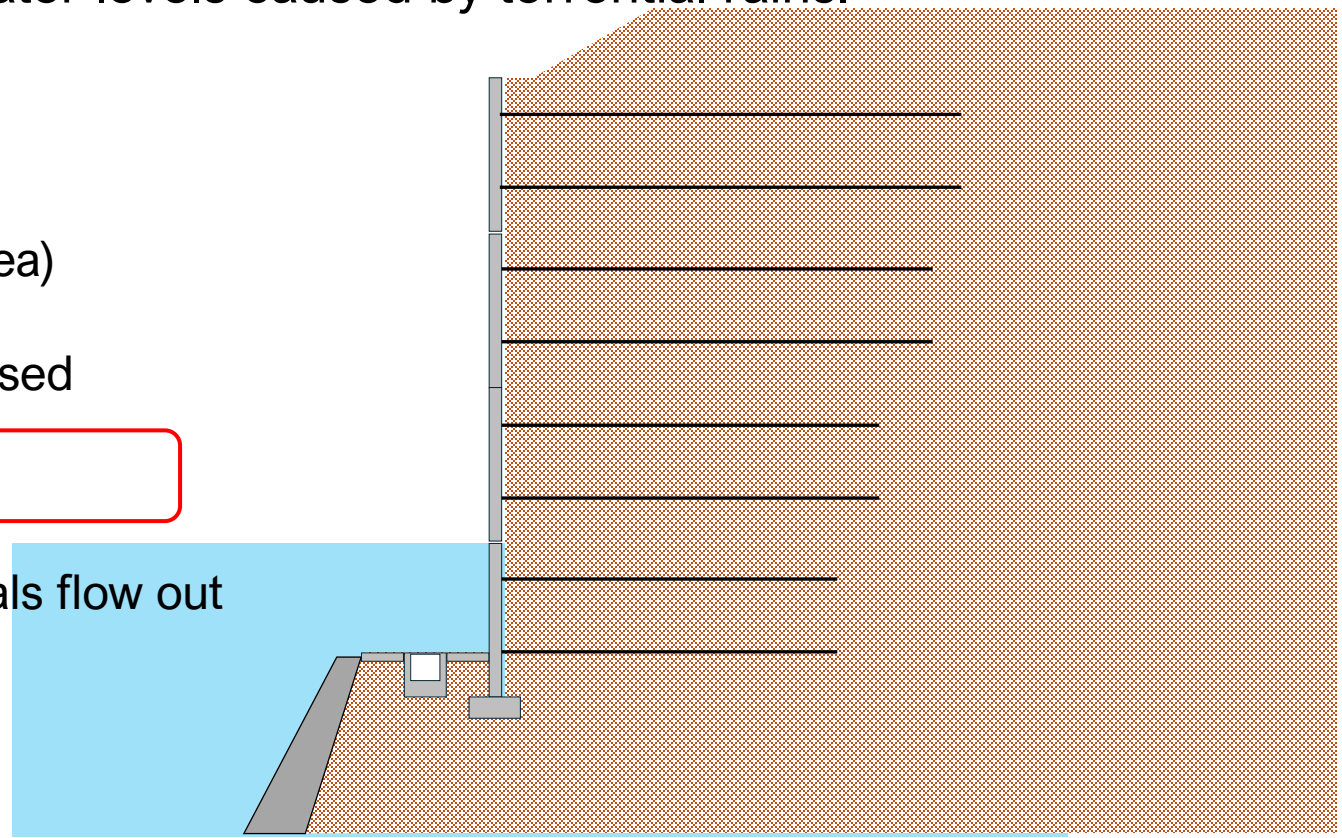
Typhoon #7~#11(2016)
72h rainfall : 488mm

Typhoon #23(2004)
24h rainfall : 440 mm

2. Countermeasure for Scouring by heavy rainfall

According to previous studies,
Increasingly, MSEs were damaged by rising water levels caused by torrential rains.

1. Flooding causes the revetment wall to wash out
2. Erosion of the foundation ground (penetration area)
3. The foundation of the reinforced soil wall is exposed
4. Embankment material leaked out
5. Wall surface materials and reinforcement materials flow out

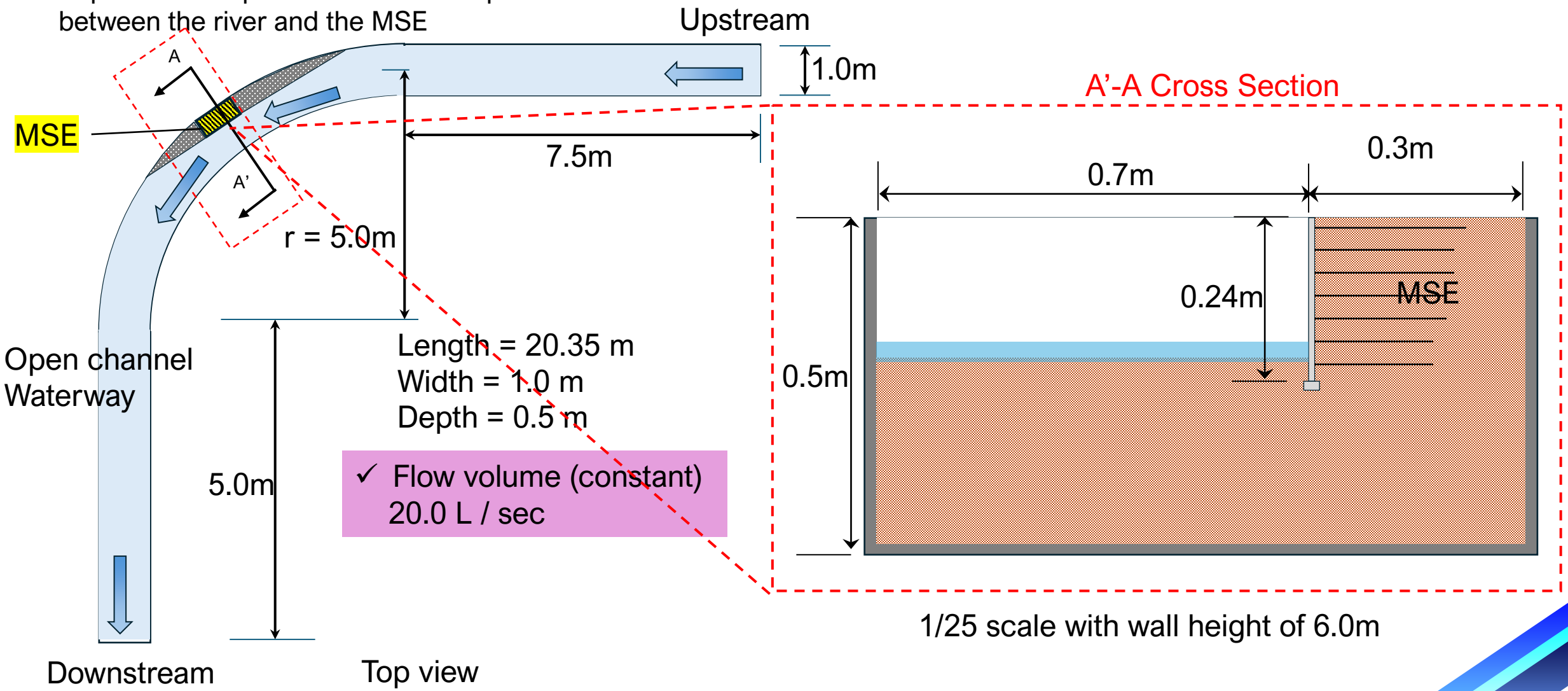


Countermeasure for scouring leads possibility of reducing damage

The effects of countermeasure was verified by open channel water flow model test

2. Countermeasure for Scouring by heavy rainfall

Open channel water flow model test apparatus
Reproduce the positional relationship
between the river and the MSE



✓ Flow volume (constant)
20.0 L / sec

1/25 scale with wall height of 6.0m

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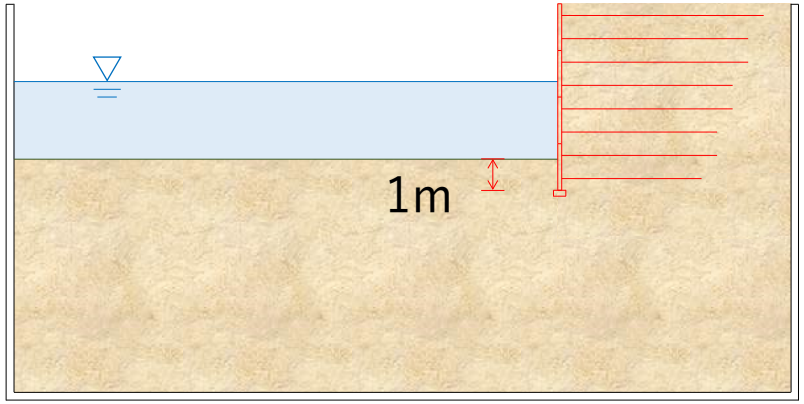
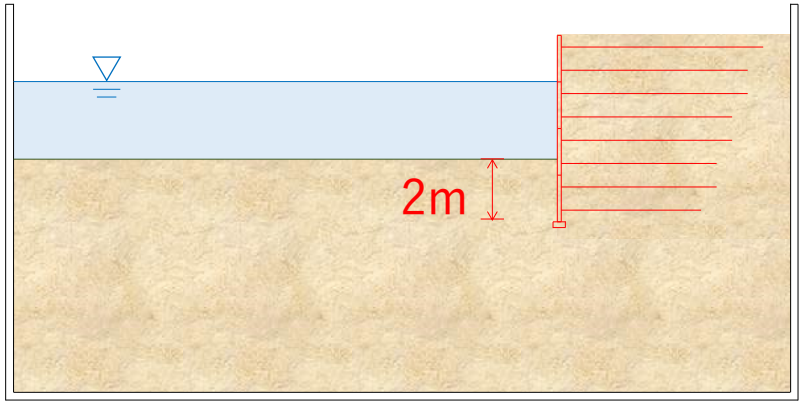
2. Countermeasure for Scouring by heavy rainfall

Cases

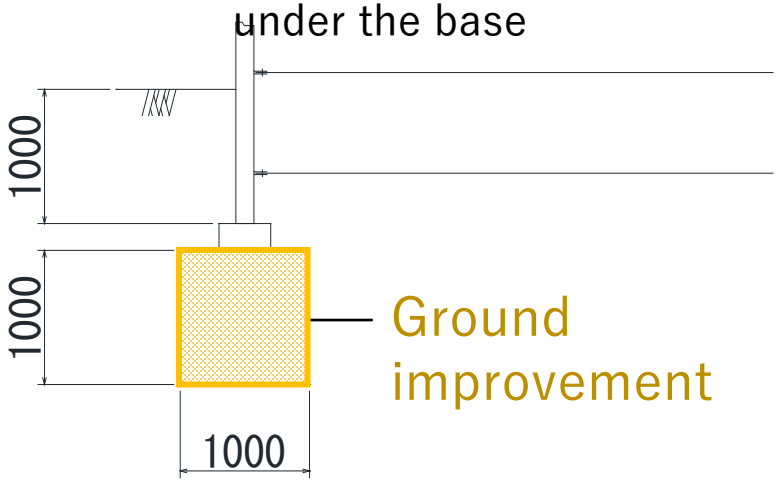
Case-1 Penetration d=1.0m



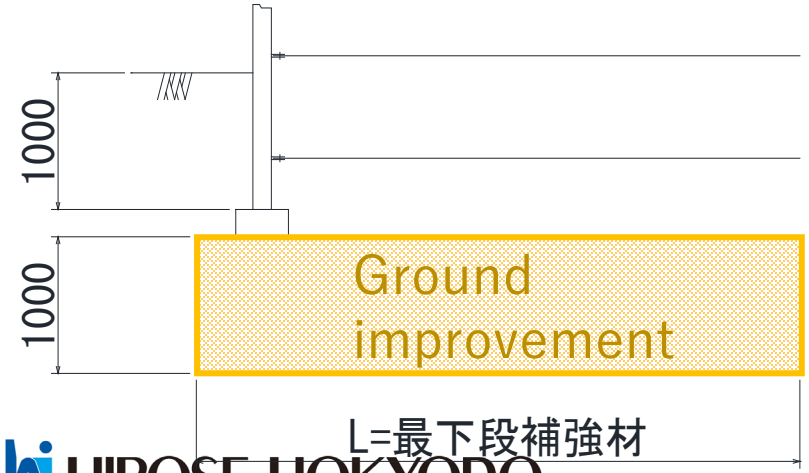
Case-2 Penetration d=2.0m



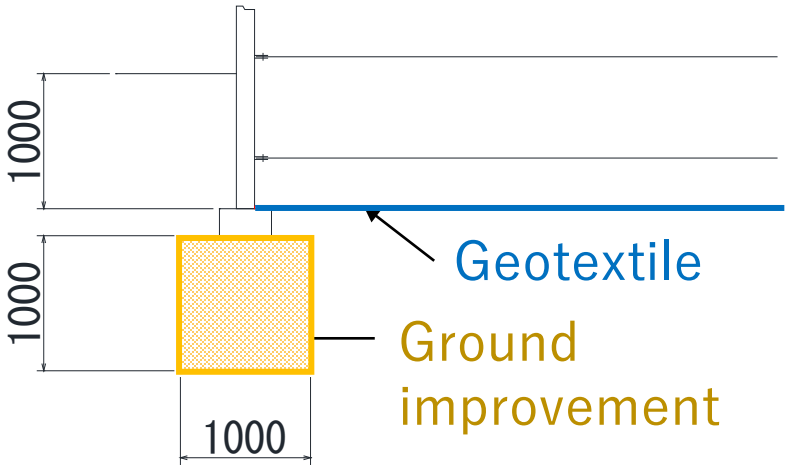
Case-3 Ground improvement under the base



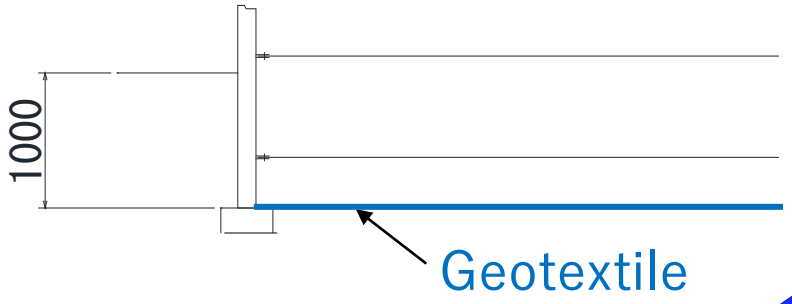
Case-4 Ground improvement under the base and backfill



Case-5 Ground improvement under the base and Geotextile on the bottom

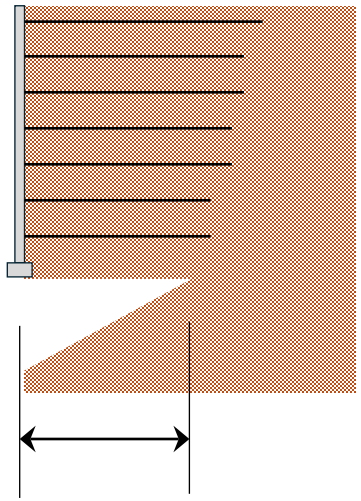


Case-6 & 7 Geotextile on the bottom

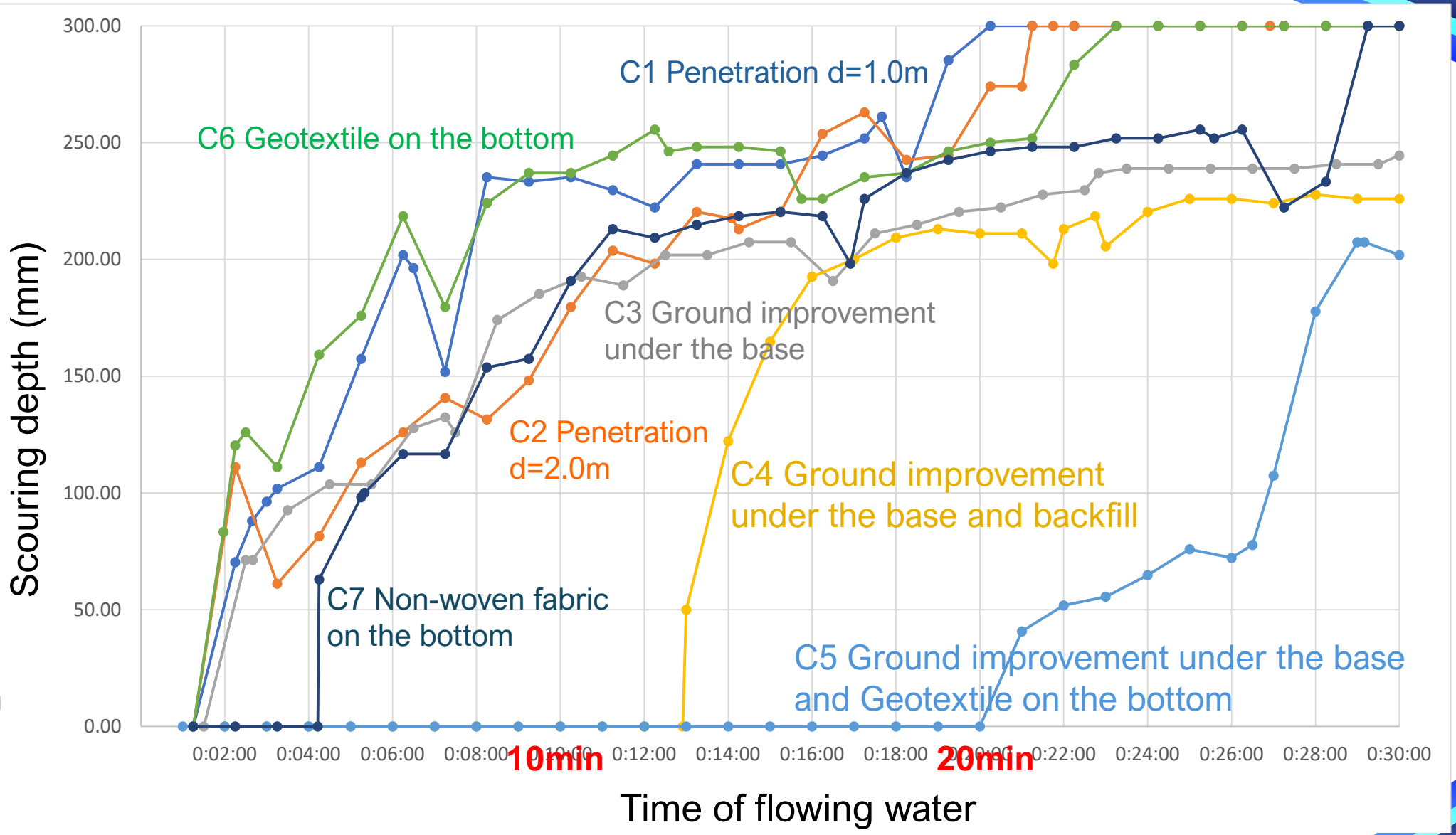


2. Countermeasure for Scouring by heavy rainfall

Results



Scouring depth
Maximum 300mm



2. Countermeasure for Scouring by heavy rainfall

Conclusions

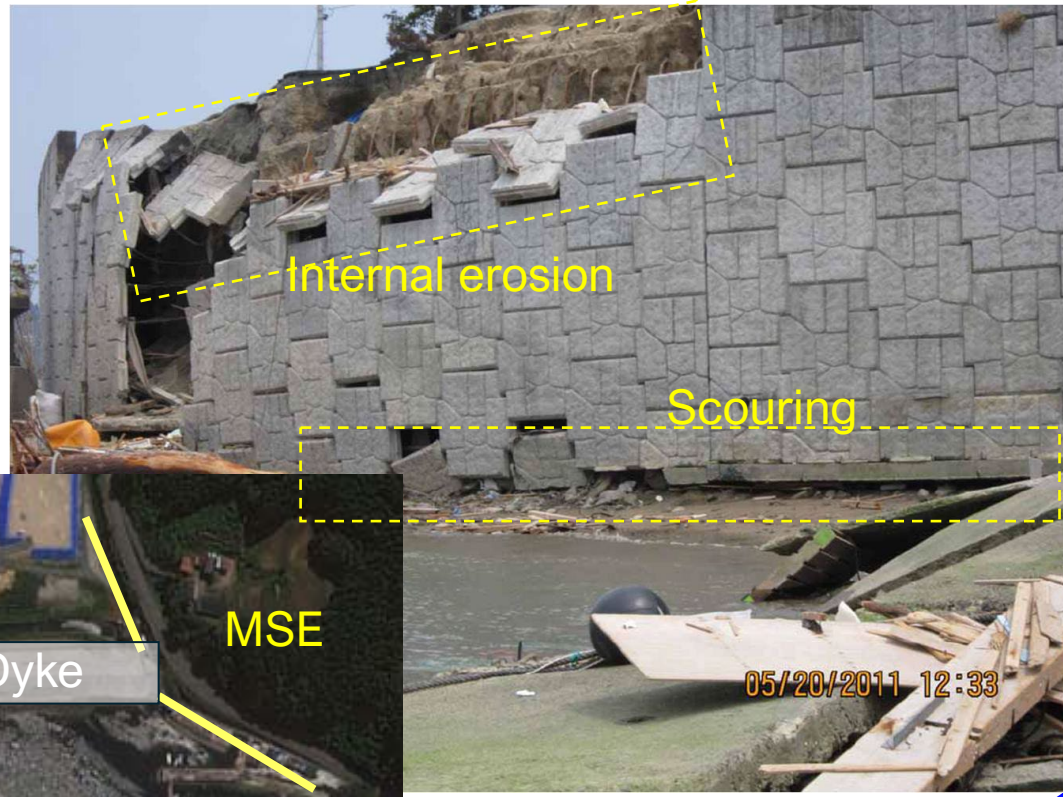
- Ground improvement was effective against scouring.

- In the case where **both ground improvement and geotextile** are used together, the effect against scouring was became higher.

- Geotextile alone was not effective in controlling leakage due to deflection caused by the weight of the backfill.

3. Tsunami Resistance and Seawall

In the 2011 Tohoku earthquake, infrastructure was severely damaged by the earthquake and by the tsunami.
Most of the MSEs were sound against both disasters.
But a few sites were damaged by the tsunami due to some factors.



The dyke collapsed, opening the connection and causing internal erosion.

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3. Tsunami Resistance and Seawall

MSE was adopted for the seawalls of Fukushima Daiichi Nuclear Power Plant based on its results of short damage from tsunami.
Ashcrete was used for backfill material.

4. MSE behind abutment

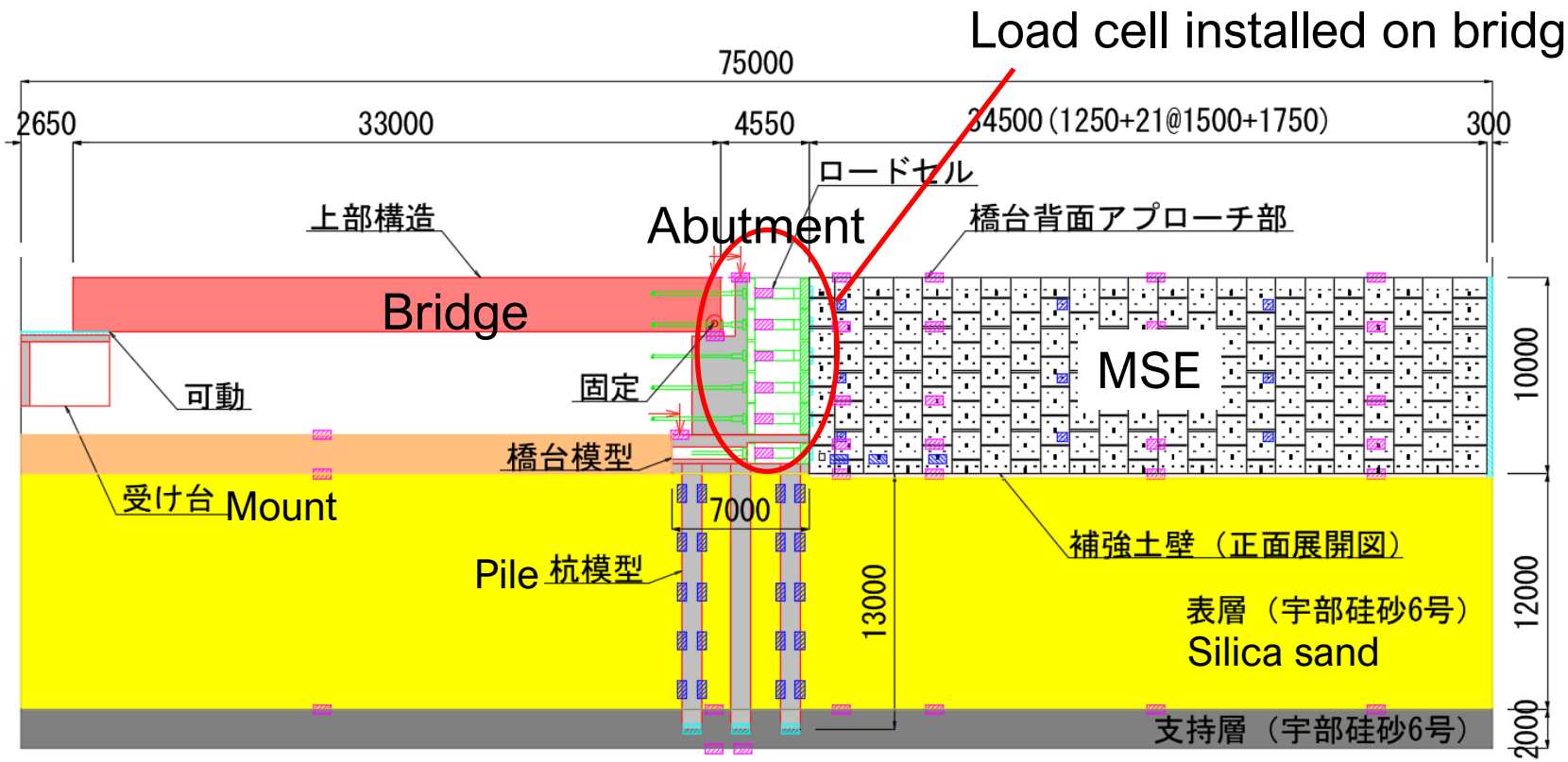
In Japan, MSEs are often constructed **behind bridge abutments**.

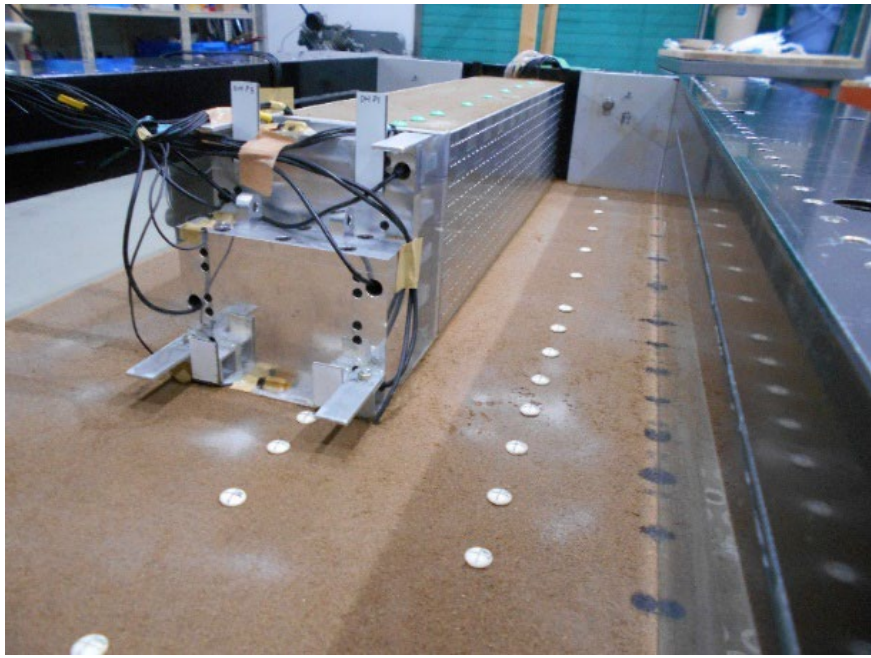
However, **the application of MSE has been restricted in 2017** because the forces acting on the abutments are unclear.

Therefore, the forces acting on the abutments at static and seismic conditions were verified by **dynamic centrifuge model tests**.

4. MSE behind abutment

Dynamic centrifuge model experiment (1/50 model, full-scale H=10m)





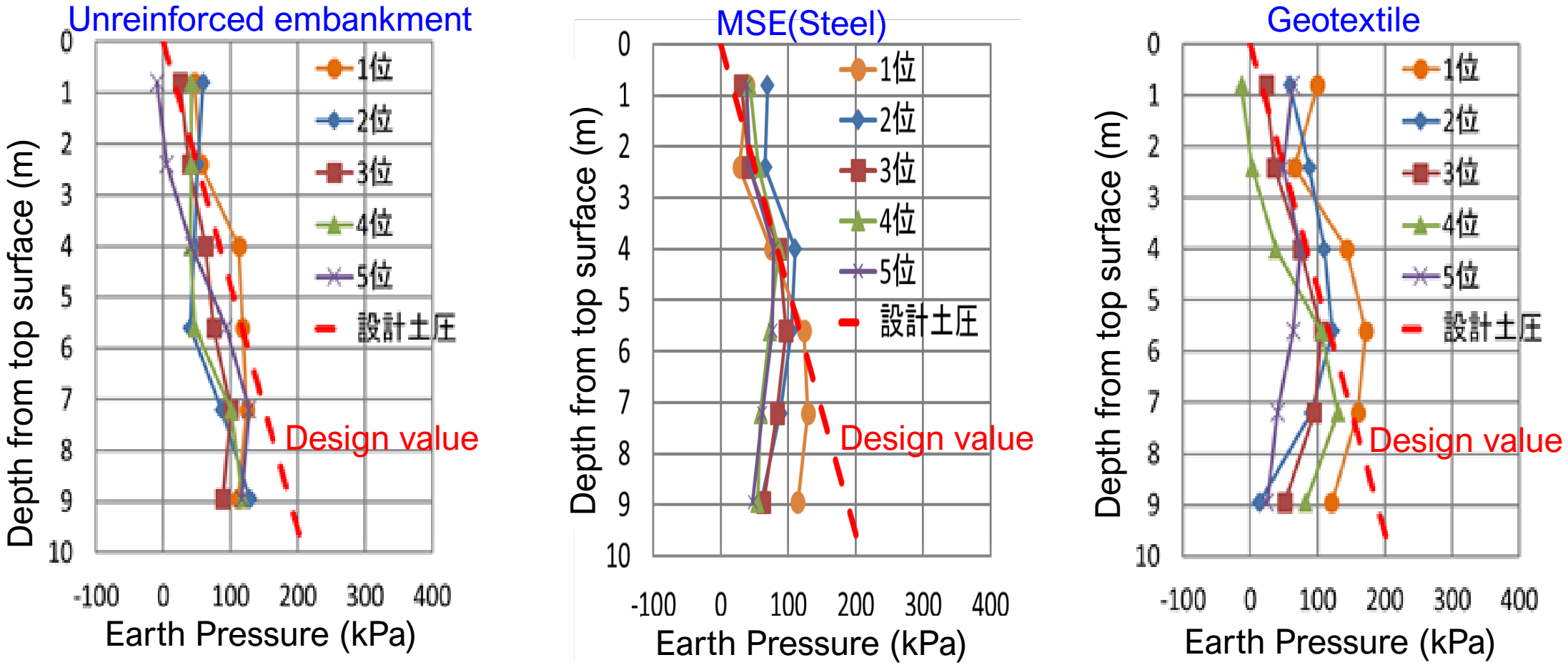
Shaking conditions・・・Large-scale earthquake (Hyogo-ken Nanbu earthquake 1995)

3 cases : Unreinforced embankment, MSE (steel strip) and geotextile on back of abutment.

4. MSE behind abutment

Results

Distribution shape of top 5 earth pressure positions in time history



No significant difference in soil pressure distribution shape between MSE (steel) and other two and each earth pressure was similar to the design value

4. MSE behind abutment

Conclusions

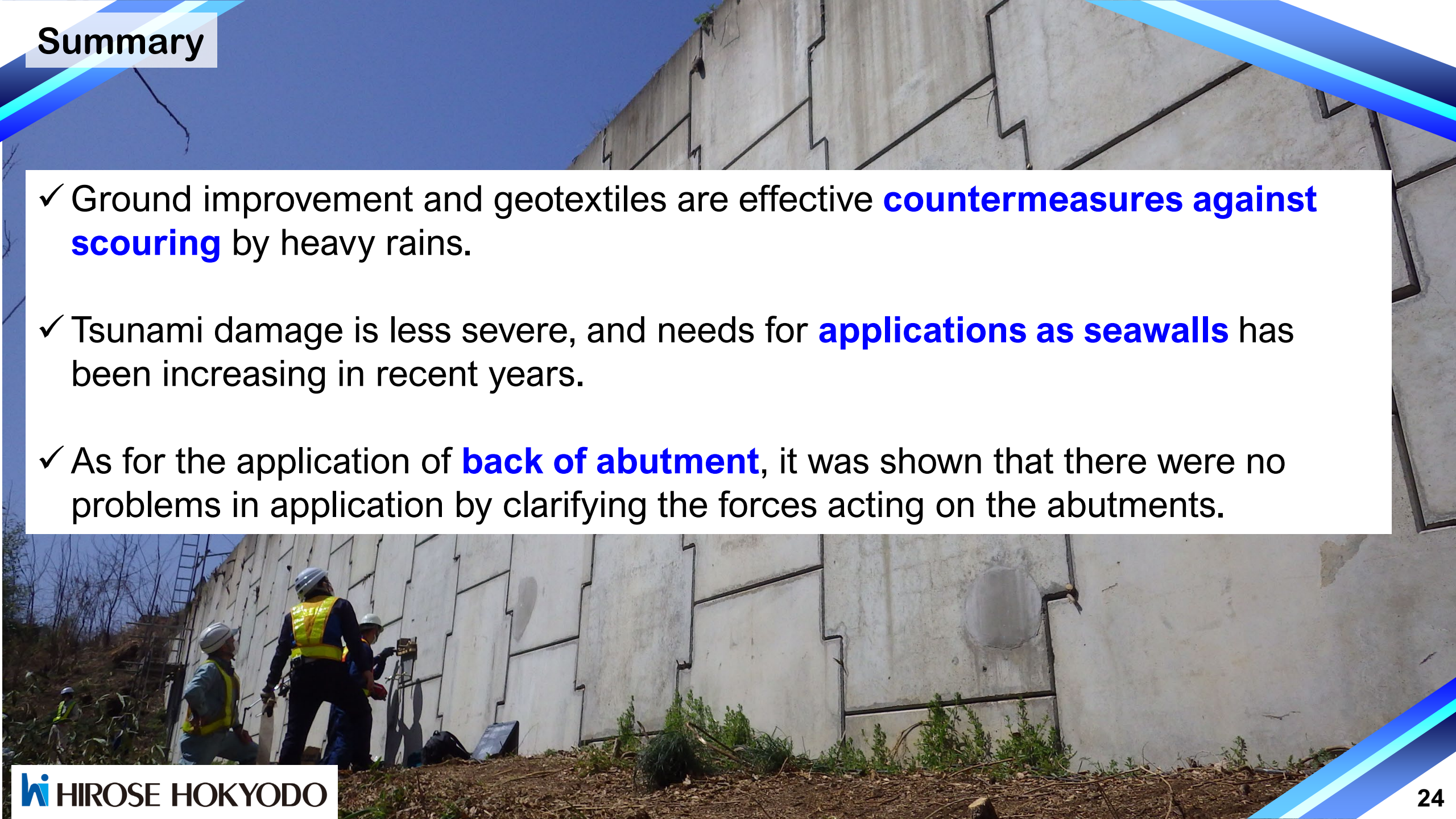
- There is no significant difference between unreinforced embankment and MSE in the distribution shape of earth pressure acting on the abutment during a large earthquake.

- When reinforced soil is applied to the back of the abutment, the same **earth pressure as that of the embankment should be considered**.

It became clear that there was no problem in applying earth pressure to the abutment in the design.

Summary

- ✓ Ground improvement and geotextiles are effective **countermeasures against scouring** by heavy rains.
- ✓ Tsunami damage is less severe, and needs for **applications as seawalls** has been increasing in recent years.
- ✓ As for the application of **back of abutment**, it was shown that there were no problems in application by clarifying the forces acting on the abutments.



Xin cảm ơn

Thank you for your kind attention