

# **Development of repair method using polymer for ballasted tracks with a high-mixture ratio of fine particles**

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# Outline

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- Background of this study
- Outline of the new repair method by polymer-stabilized ballast bed with a high- mixture ratio of fine particles
- Direct shear test
- Full-scale model test
- Conclusions



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## ■ Background of this study

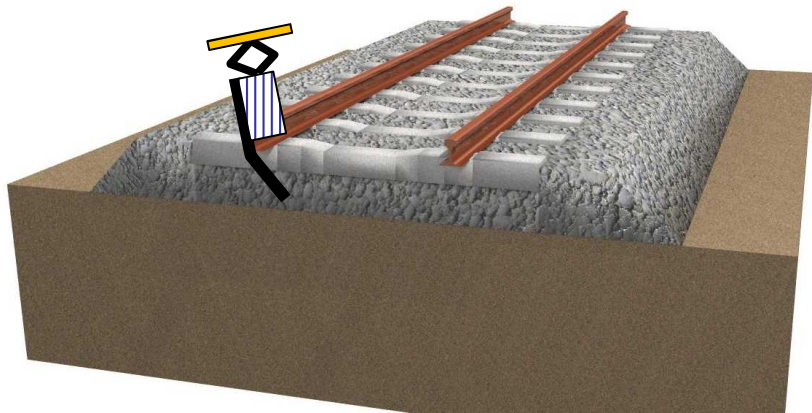
- Outline of the new repair method by polymer-stabilized ballast bed with a high- mixture ratio of fine particles
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## Background of this study

*Ballasted bed with **low**-mixture ratio of fine particles*

Track repair method by tamping

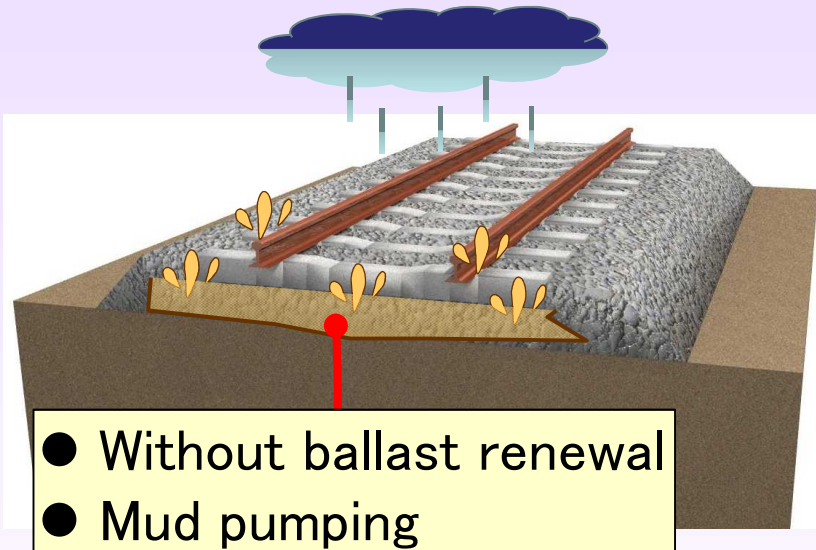


【Track maintenance on ballasted tracks with low-mixture ratio of fine particles】

The track irregularity after the track repair by tamping is small and the growth of track irregularity is also small.

## Background of this study

### *Ballast bed with **high**-mixture ratio of fine particles*



- Track irregularity tends to increase because of a decrease in a ballast strength and mud pumping due to an increase of water content.
- It is necessary to renew the ballast as drastic measures, however ballast renewal takes costly.

**⇒ We developed the effective track repair method without ballast renewal for that ballast bed.**

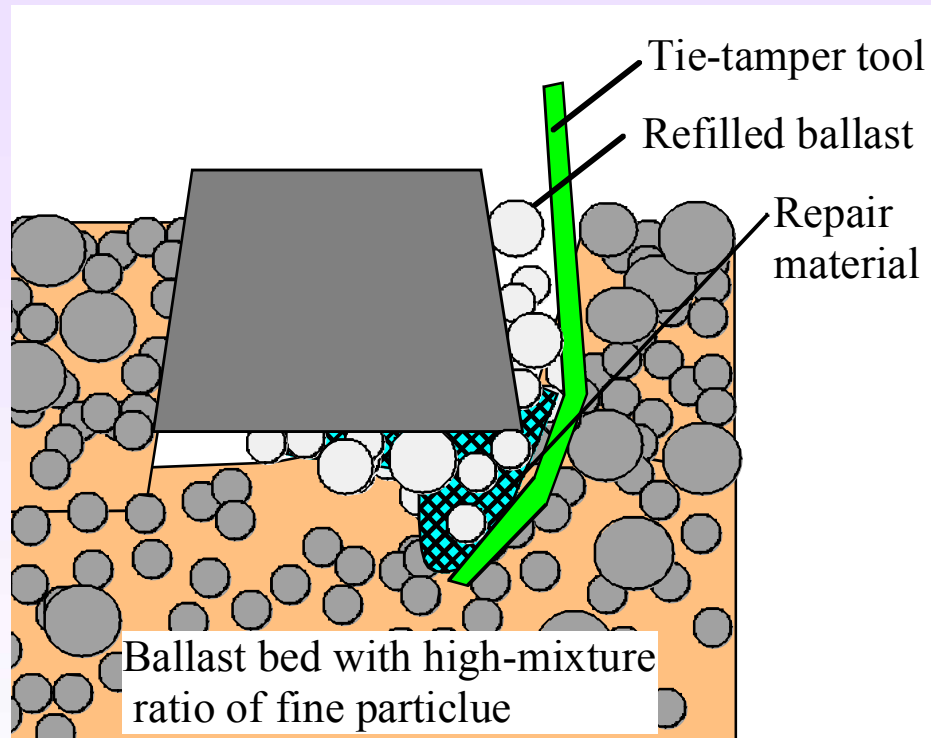
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## Outline of the new repair method by polymer- stabilized ballast with a high- mixture ratio of fine particles



### 【Feature of polymer- stabilized method】

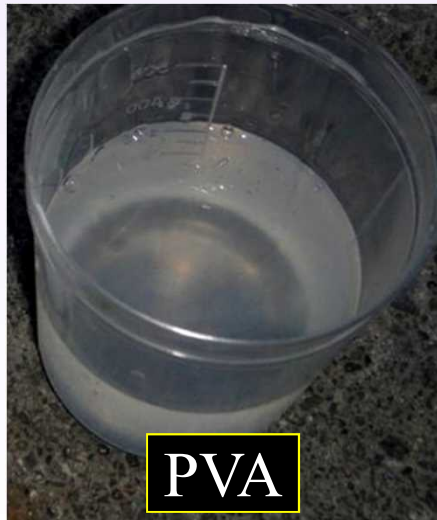
- This method can be expected to reduce the track settlement without ballast renewal.
- This method is to perform the tamping by tie-tamper after throwing in the repair material.
- Fouled ballast is stabilized by this method .

- Prevent of the reduction of the fouled ballast strength in a high water content
- Increase of the bearing capacity of sleepers by increasing the ballast strength due to stabilization of fouled ballast.

## Outline of polymer- stabilization method

### Components of repair material

Material	Specification	Remark
PVA	Poly vinyl alcohol water	Soil stabilizer
Accelerant material	Sodium silicate	Soil stabilizer



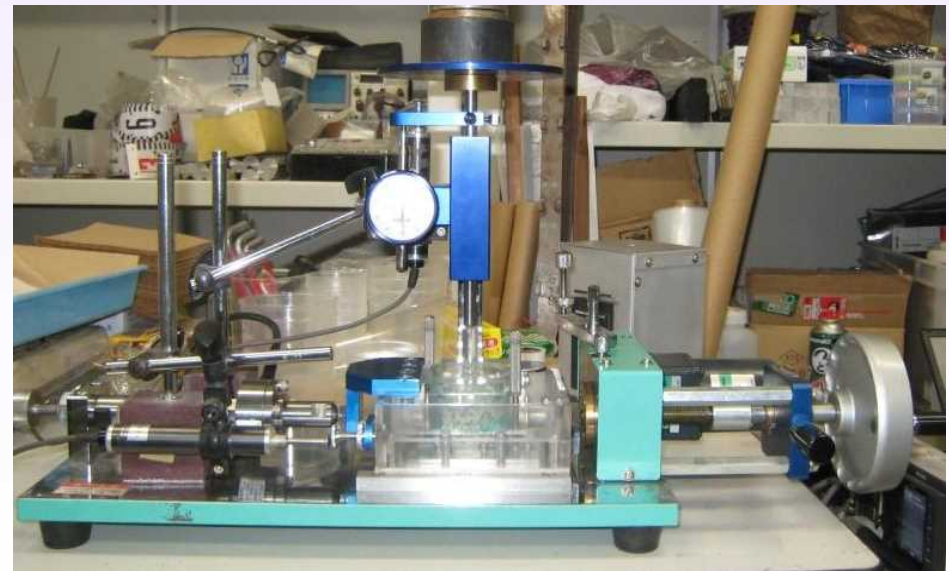
- PVA reacts with sodium silicate to form gel thereby it is possible to perform the stabilization of the fouled ballast.



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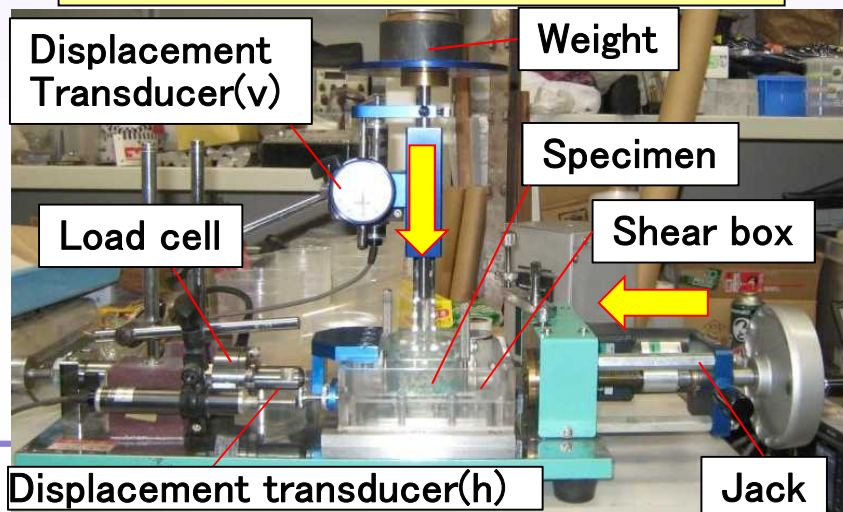
## Direct shear test

Direct shear test was performed to evaluate the strength properties of the stabilization by polymer.

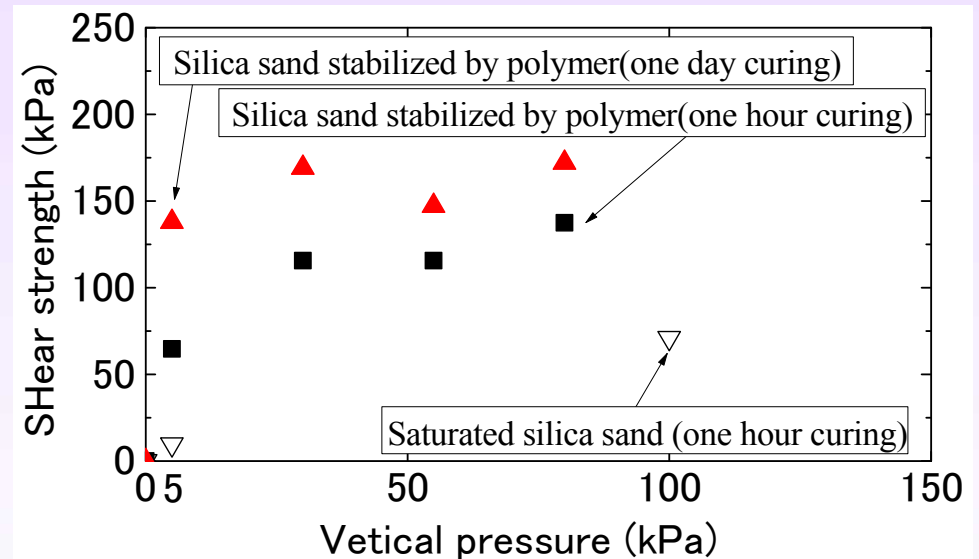
### Test case

CASE	Specimen	Curing time
1	Saturated silica sand	1 hour
2	Silica sand stabilized by polymer	1 hour 1day

### Loading test condition



### Direct shear test result



- Strength properties of polymer-stabilized ballast  
 $\Rightarrow$  Internal friction of the aggregate  
 $+ Cohesion of the polymer$

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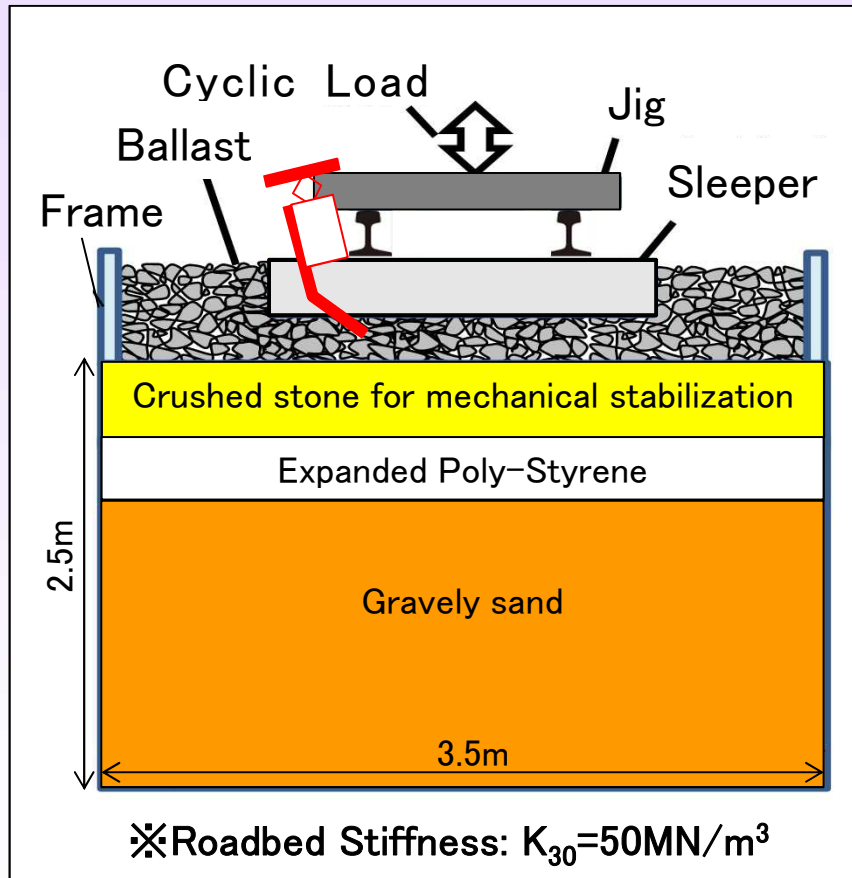
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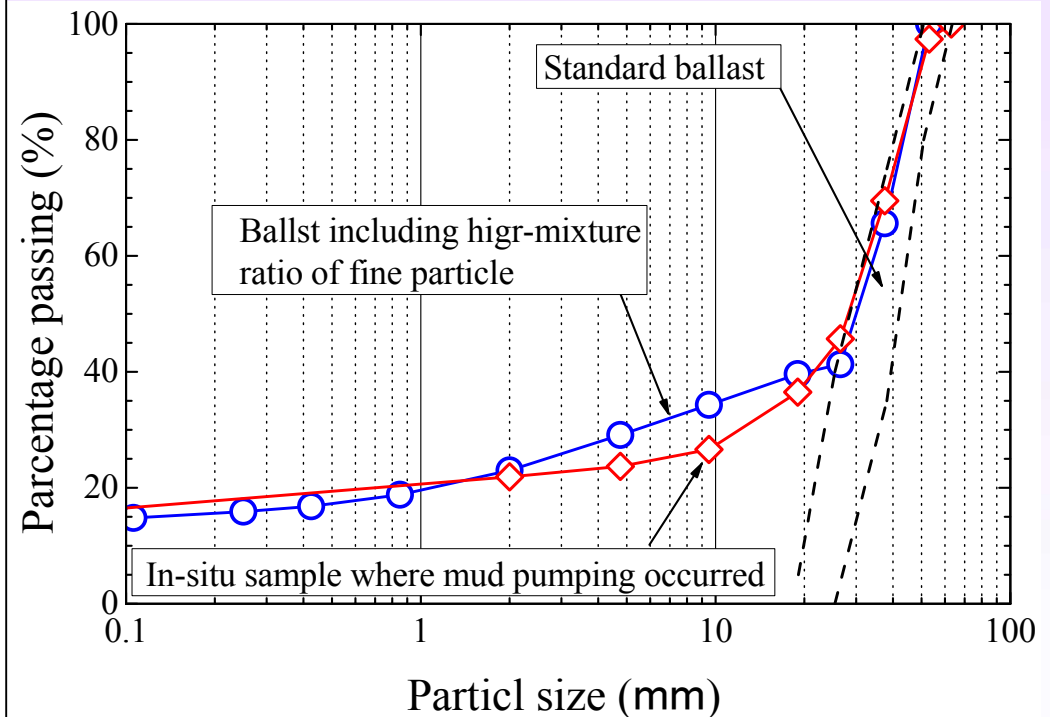


# Full-scale model test

## Schematic of full-scale model



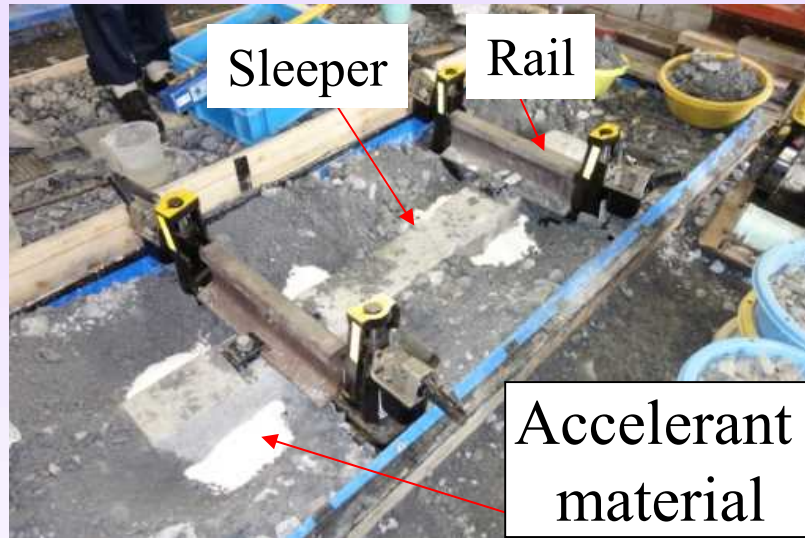
## Particle size distribution curve of ballast with a high-mixture ratio of fine particles



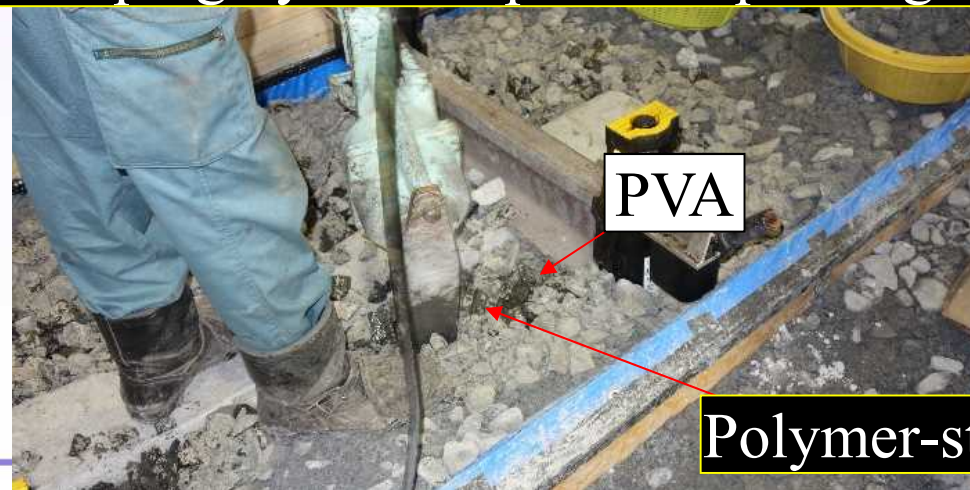
- A full-scale model test was performed to investigate the repair effect of polymer-stabilization method

# Work procedure of polymer-stabilization method

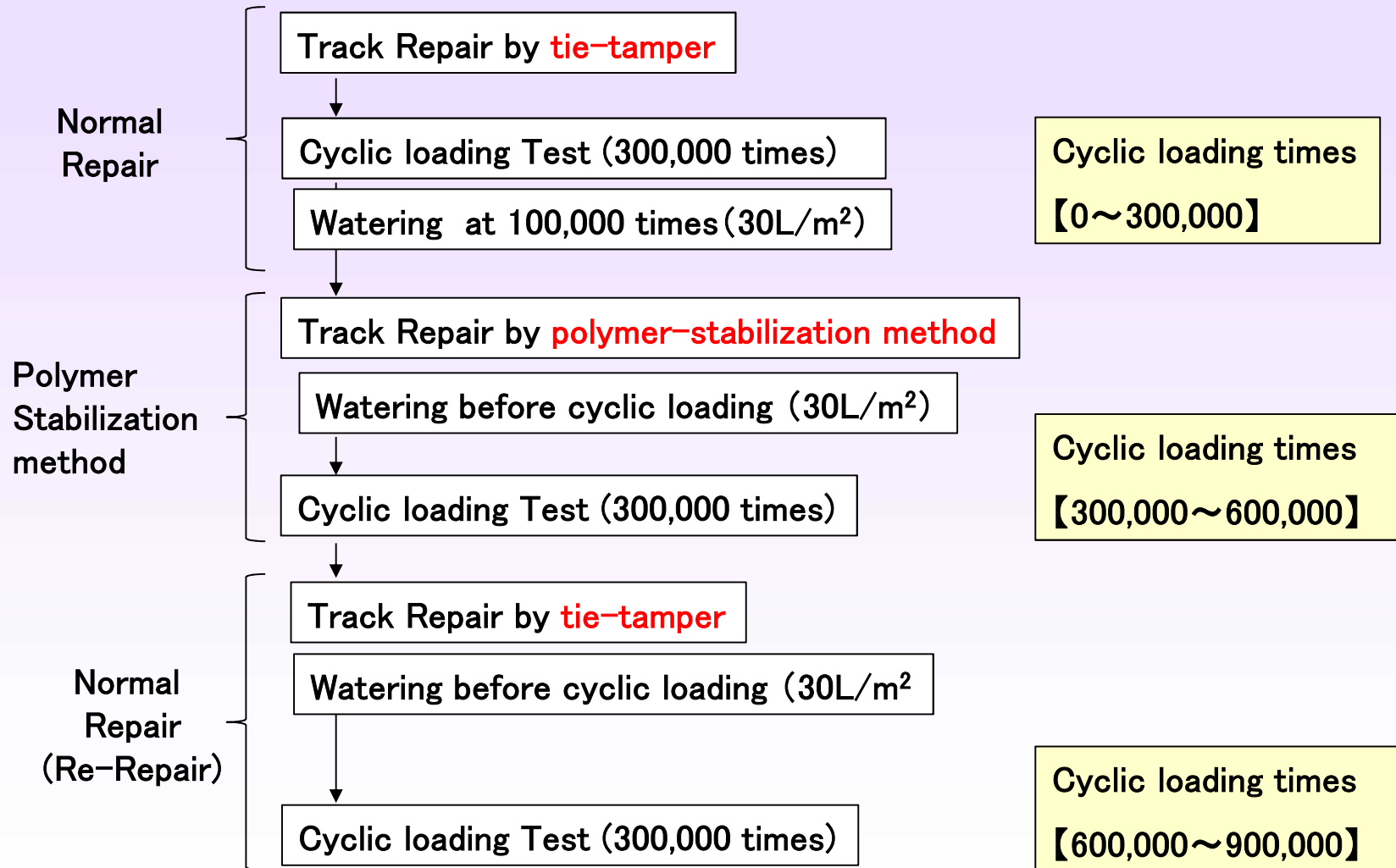
## ① Put Accelerant material under sleeper



## ② Tamping by tie-tamper after pouring PVA



# Cyclic loading test procedure

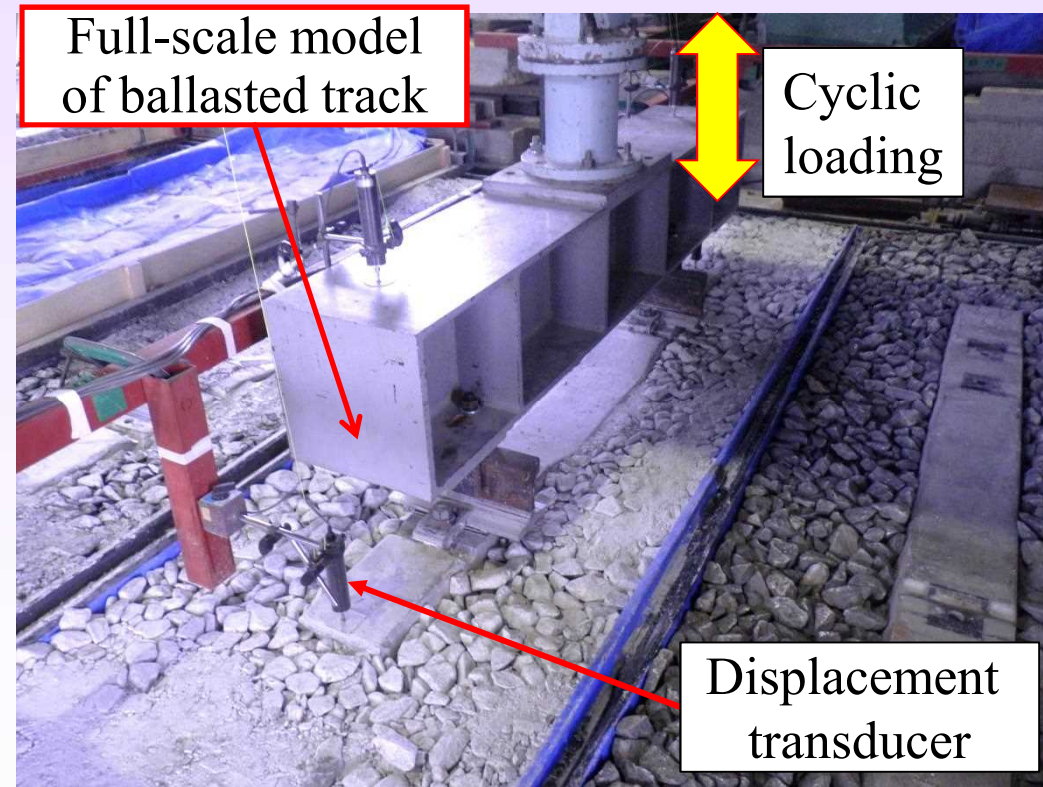


# Full-scale model test

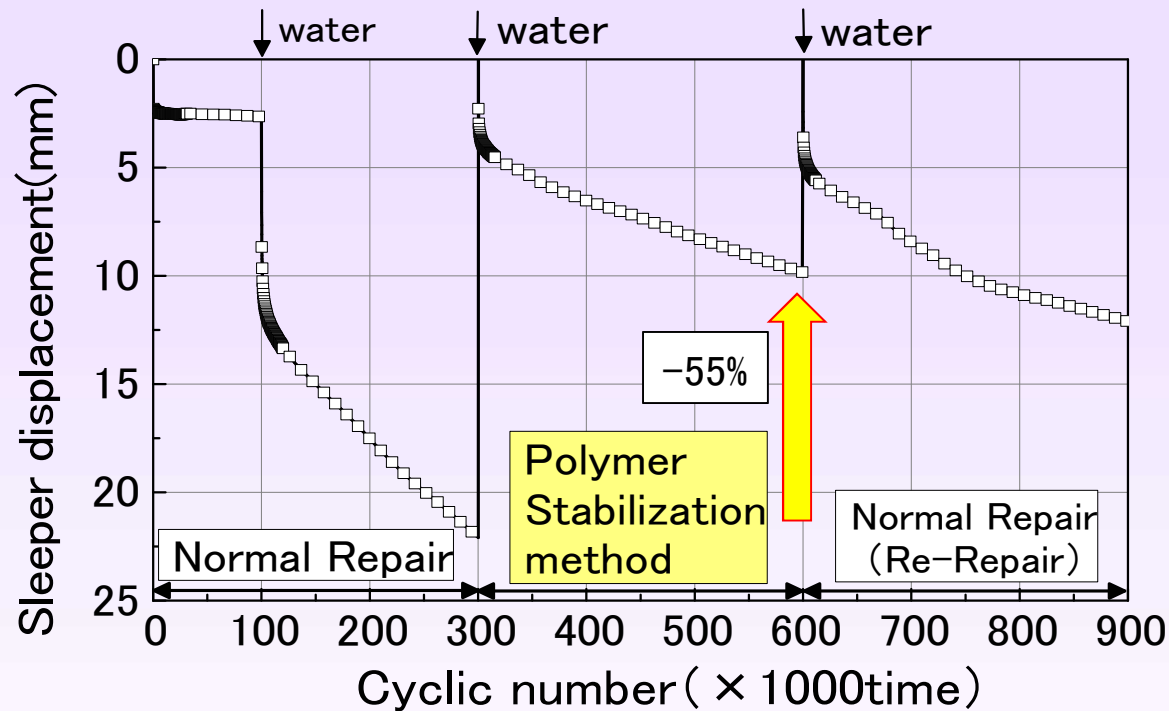
## Cyclic loading Test condition

Times of cyclic loading	900,000 (300,000 × 3case)
Frequency	5Hz
Load force (min-max)	5kN-85kN
Load wave	Sine wave
water	30L/m <sup>2</sup>

## Cyclic loading test situation



## Test result of full-scale model



- The growth of the settlement after the sprinkling water decreased by this repair method.
- Re-repair by normal repair after this method is effective, and the settlement was smaller than normal repair before this method.



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The authors performed a direct shear test and full-scale model test to confirm the validity of the repair method by polymer-stabilized ballast.

- ① By the direct shear test, the strength properties of polymer-stabilized ballast shows that the shear strength increase because of both the internal friction of the aggregate and the cohesion of the polymer.
- ② By full-scale model test, it has been confirmed that the growth of the settlement after the sprinkling water decrease by this repair method, and re-repair by normal repair after this method was effective.

**Thank you very much  
for your kind attention**

