

Recent solutions to improve the degraded ballasted tracks



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Introduction

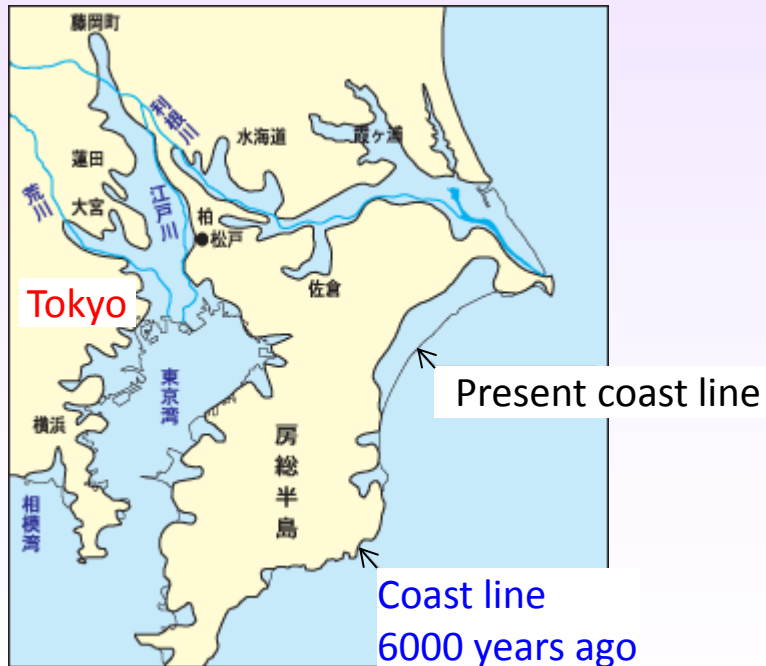
- **Important function of the ballasted track**
 - ◆ Easy to correct track irregularity by tamping.
 - ◆ Good drainage.



■ Difficult surroundings for ballasted track in Japan

◆ Soft ground.

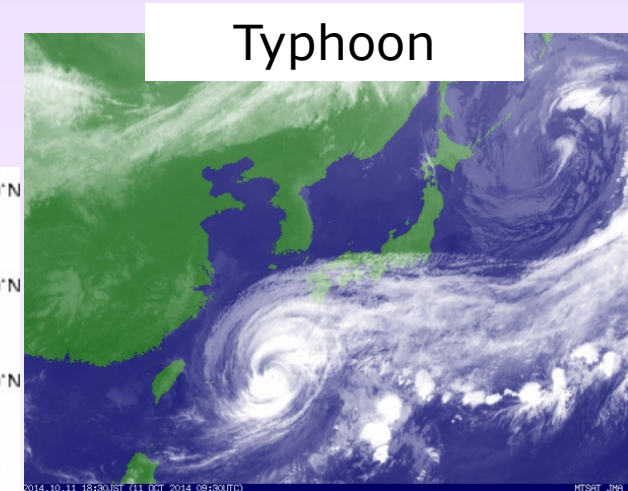
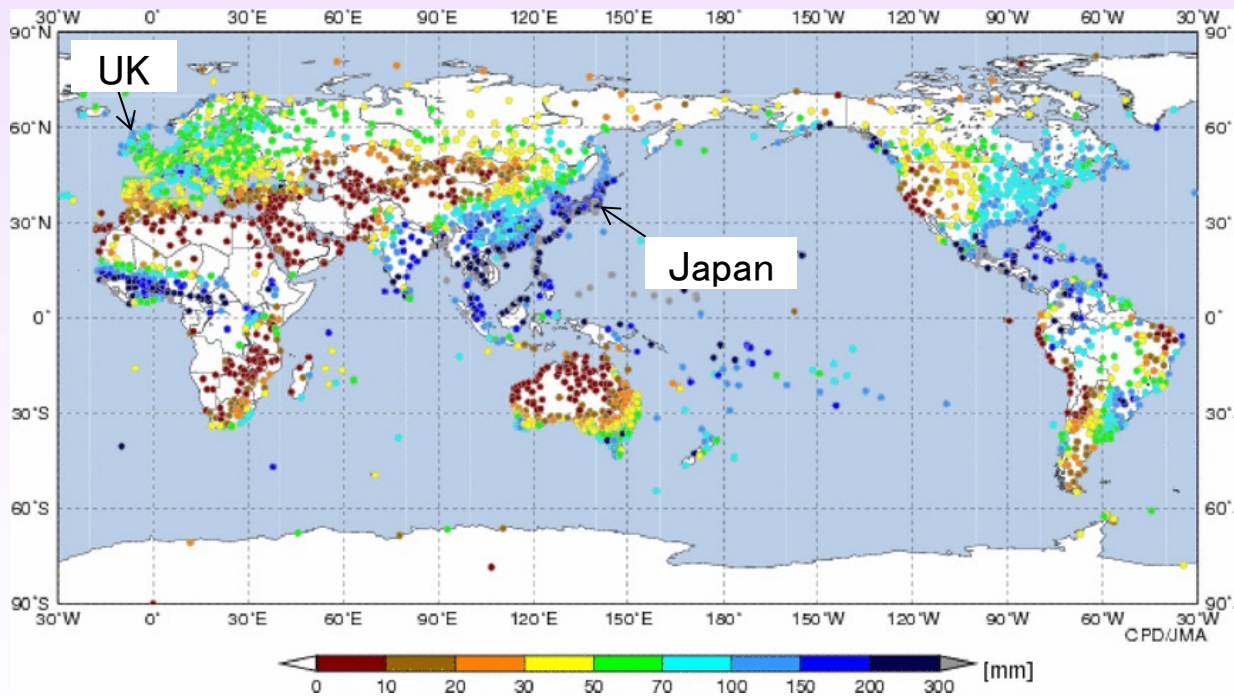
Alluvial clays are deposited at plains.
Geological ages are young.
(younger than 6000 years)



■ Difficult circumstance for ballasted track in Japan

◆ Heavy rain.

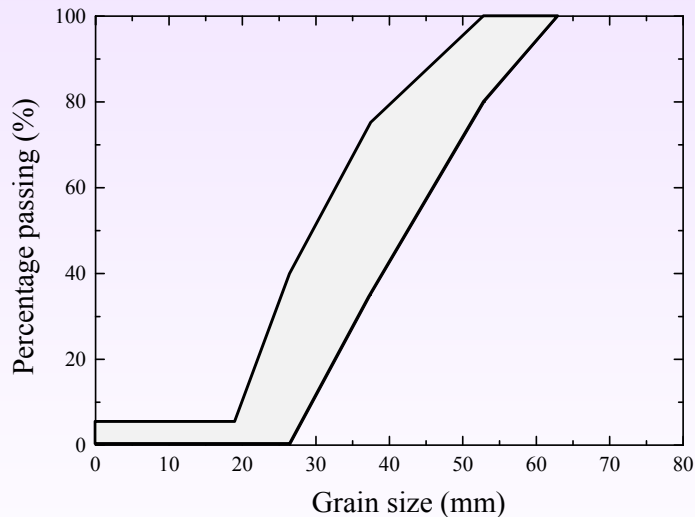
Rain fall in September (average)



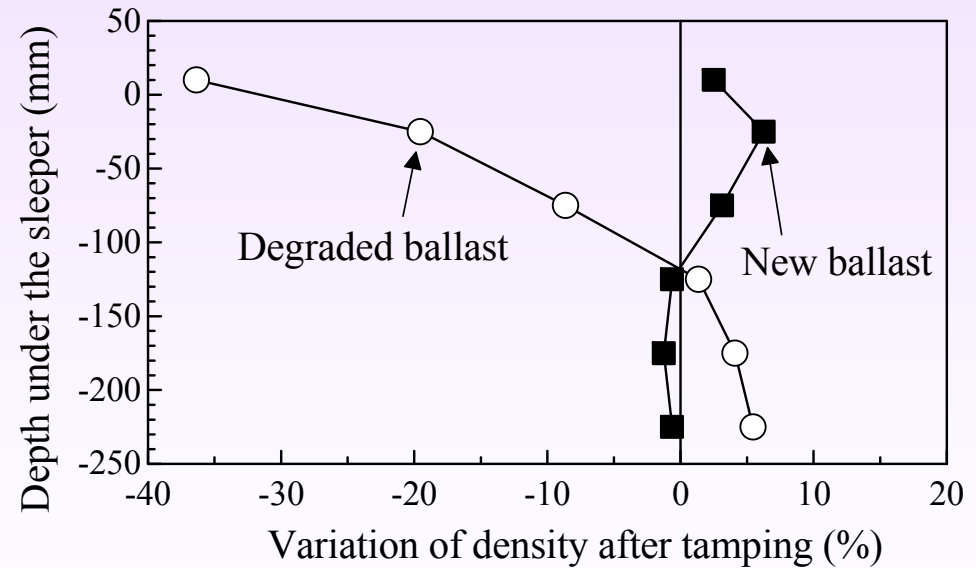
Stability of the degraded ballast

- ◆ The density of the degraded ballast does not increase by tamping.

Grain size distribution of new ballast



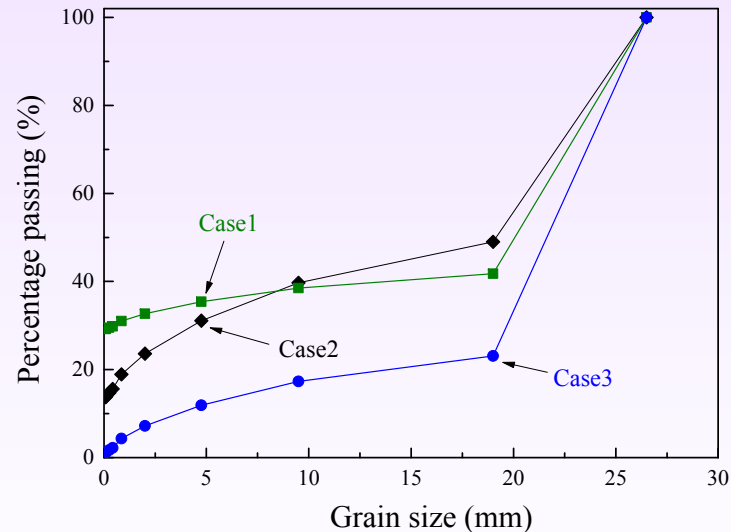
Density after the tamping



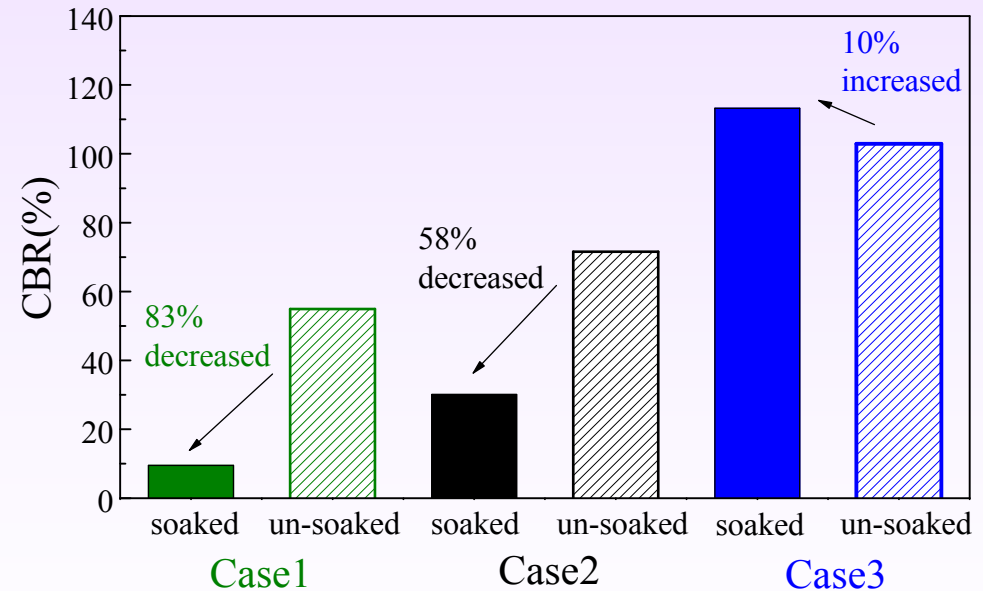
Stability of the degraded ballast

- ◆ CBR value of the degraded ballast significantly decreases after the soaking.

Grain size distribution of degraded ballast



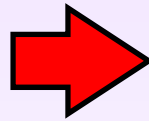
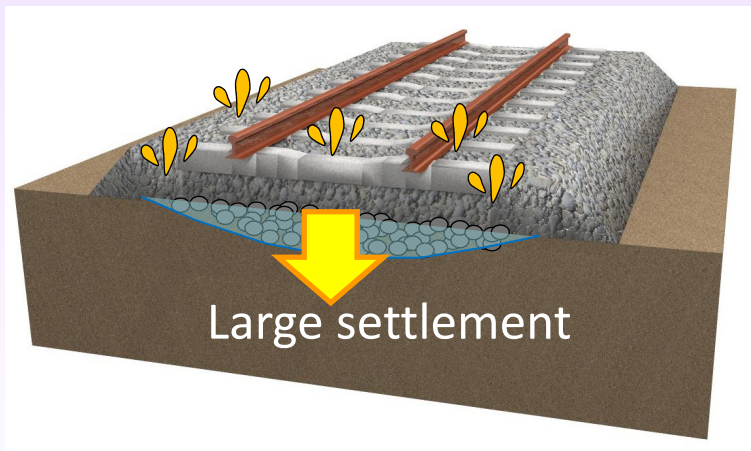
CBR test result



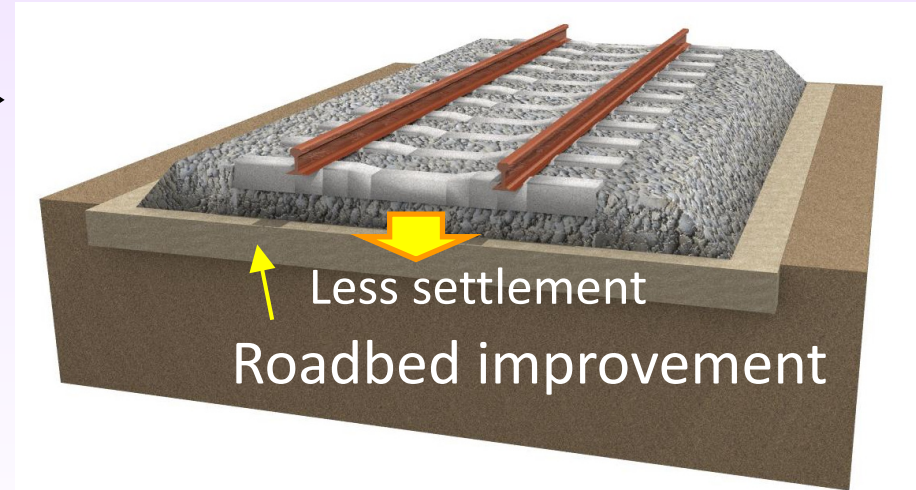
❏ Roadbed improvement

- ◆ Settlement of the ballasted track becomes less after roadbed improvement.

Without improvement

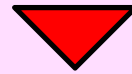


Roadbed improvement



■ Conventional roadbed improvement

Conventional roadbed improvement method:
Crushed stone, steel slag, cement treated material.

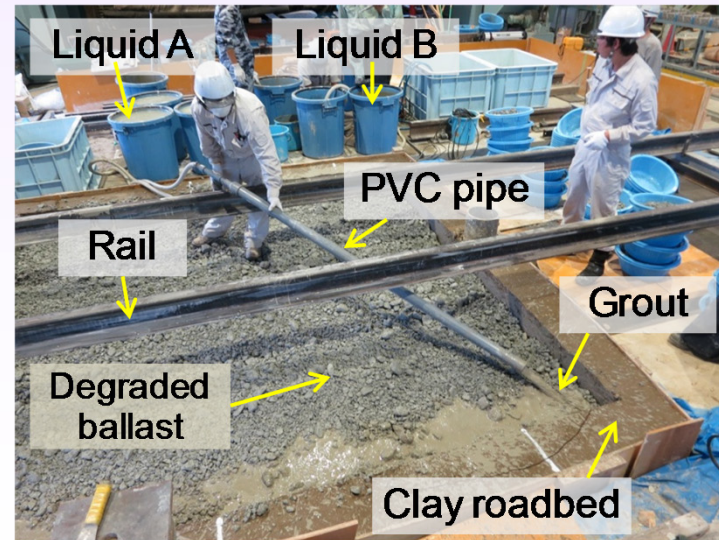
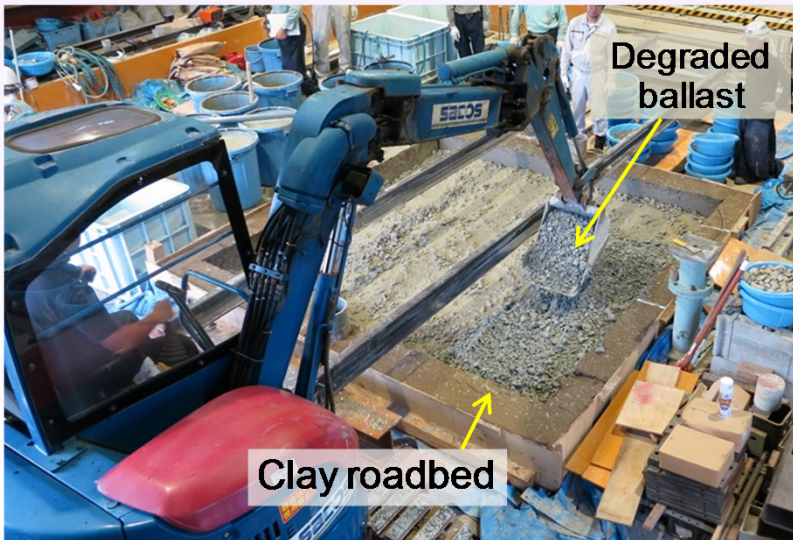
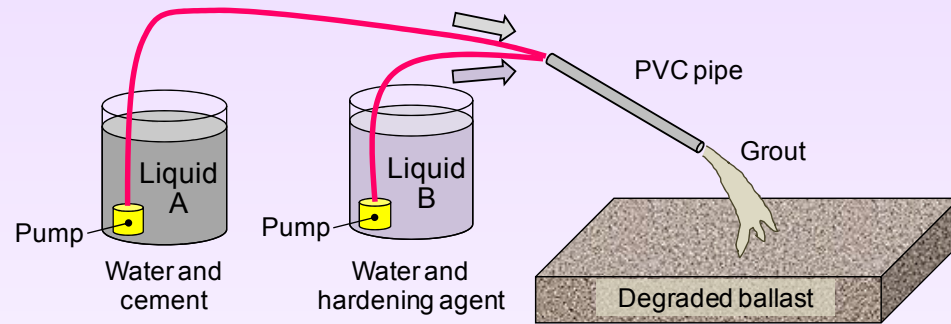


Sufficient compaction work was necessary.

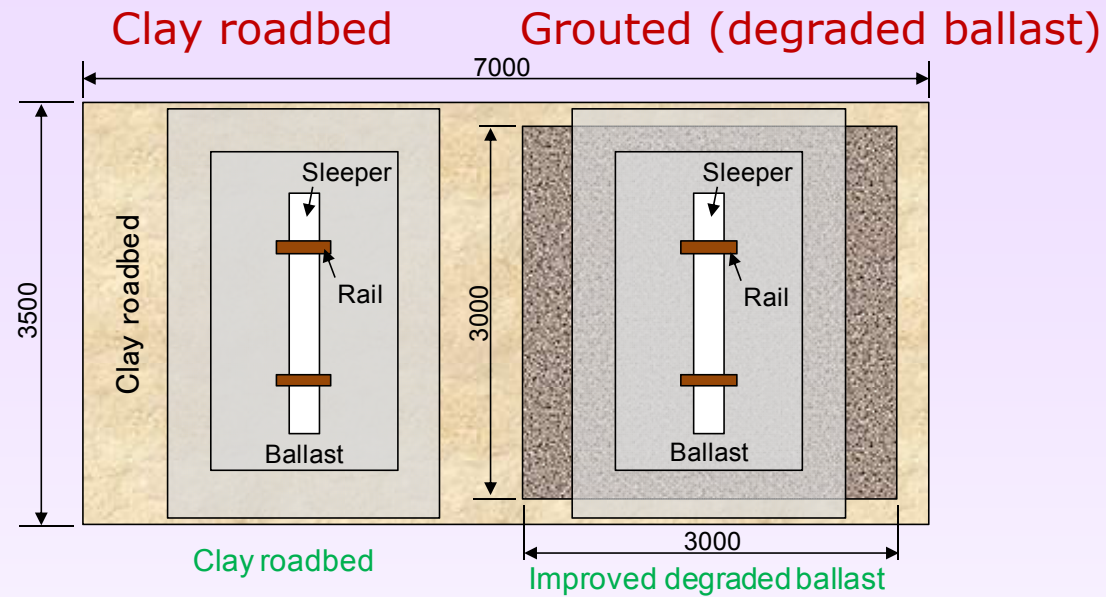


■ New roadbed improvement method

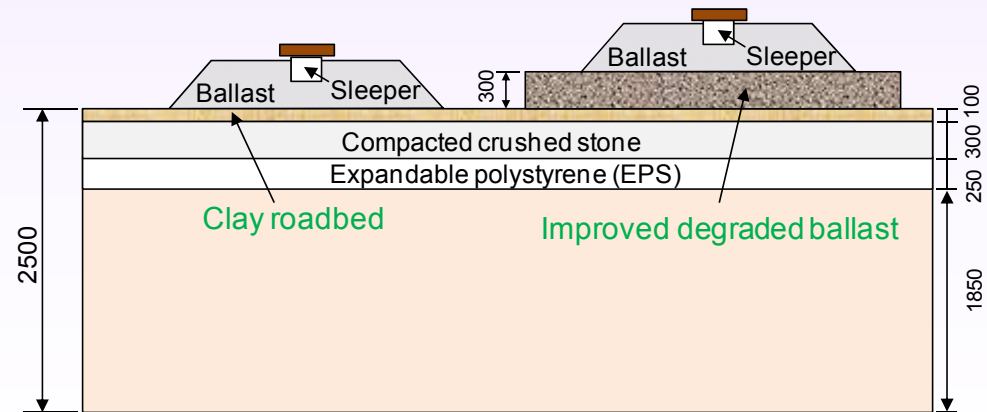
- ◆ Reusing degraded ballast mixed with cement grout.



■ Test cases (Clay roadbed)



Plain view

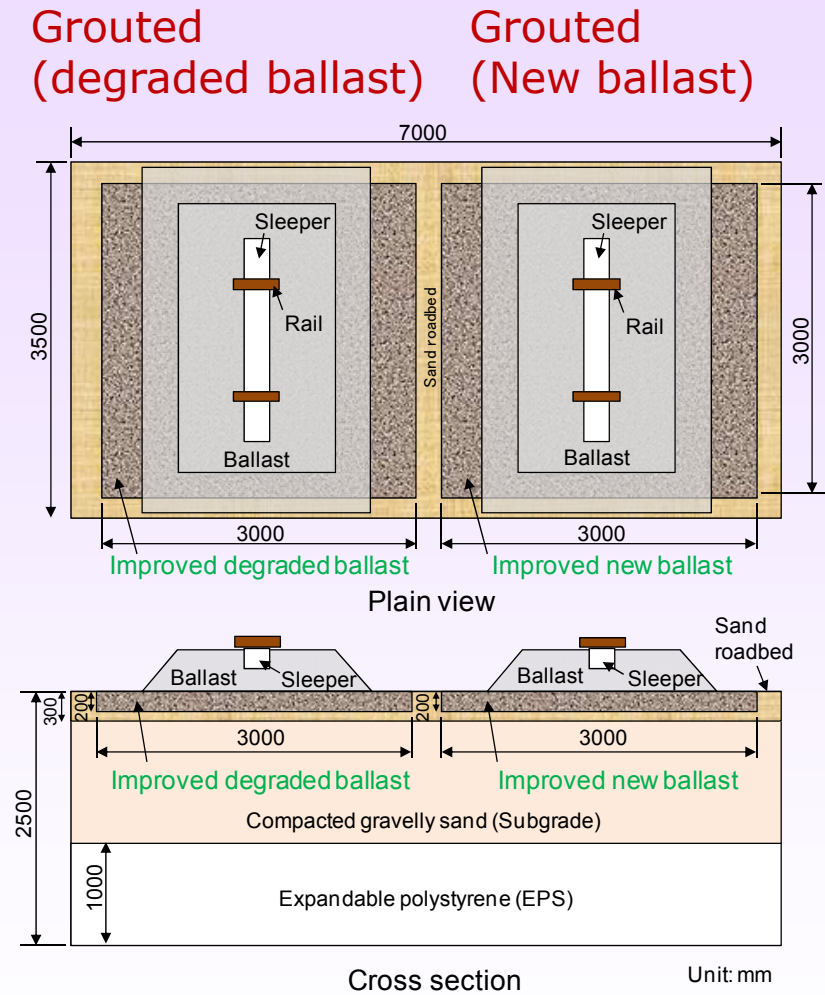
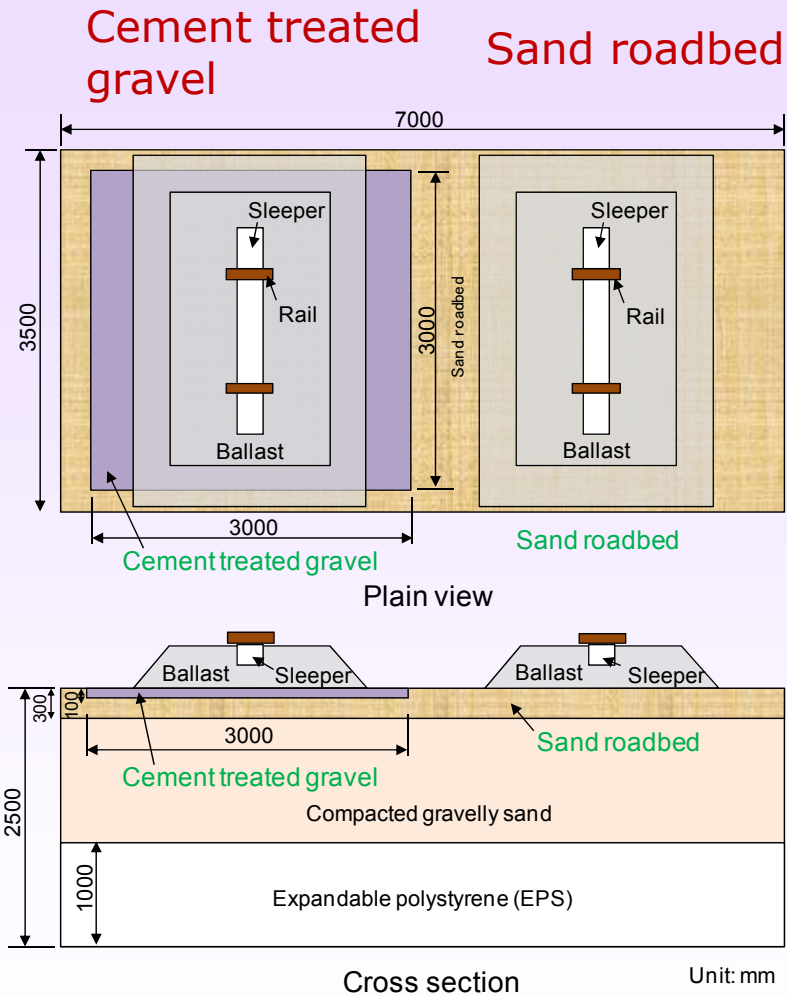


Unit: mm

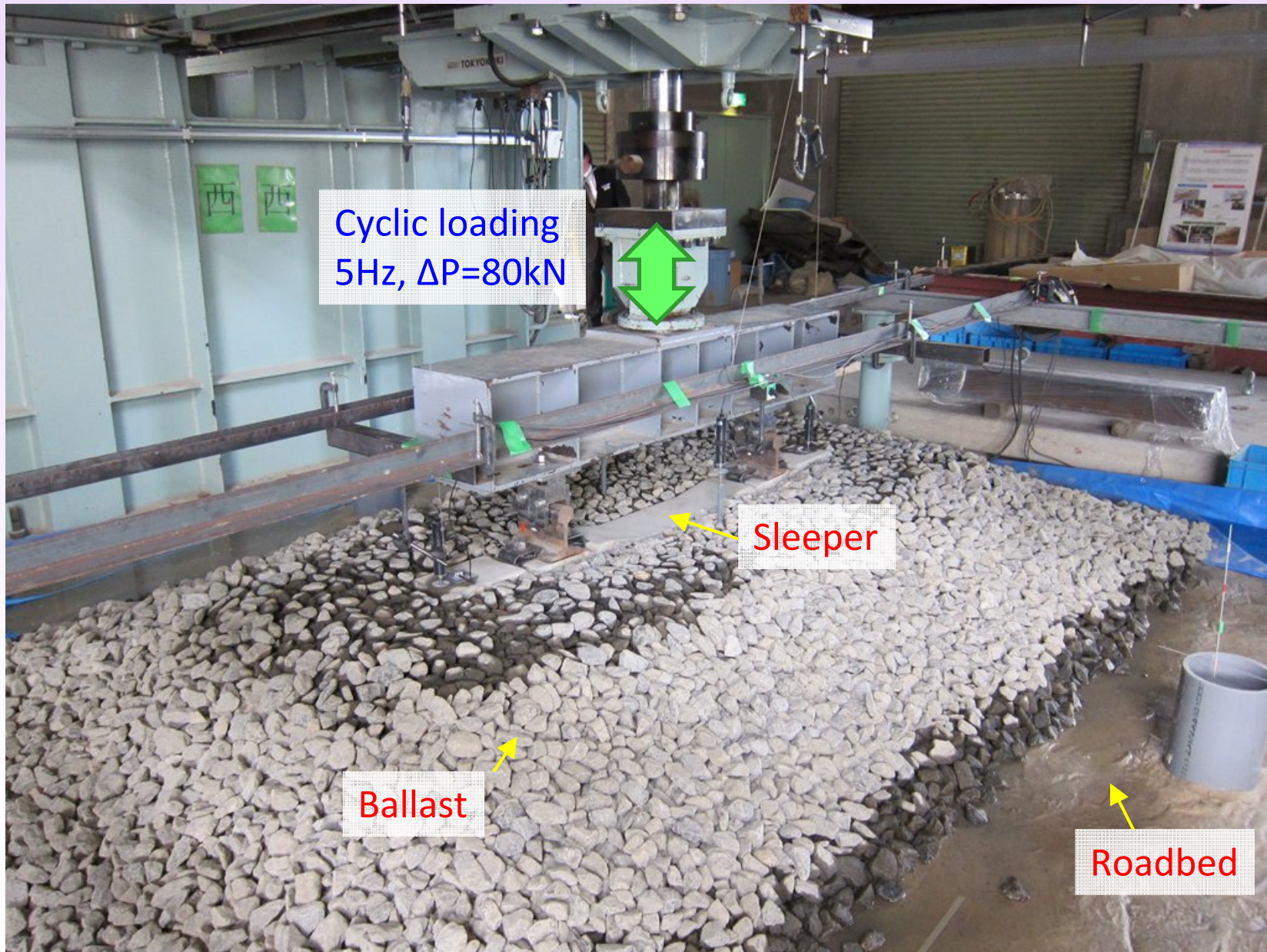
Cross section



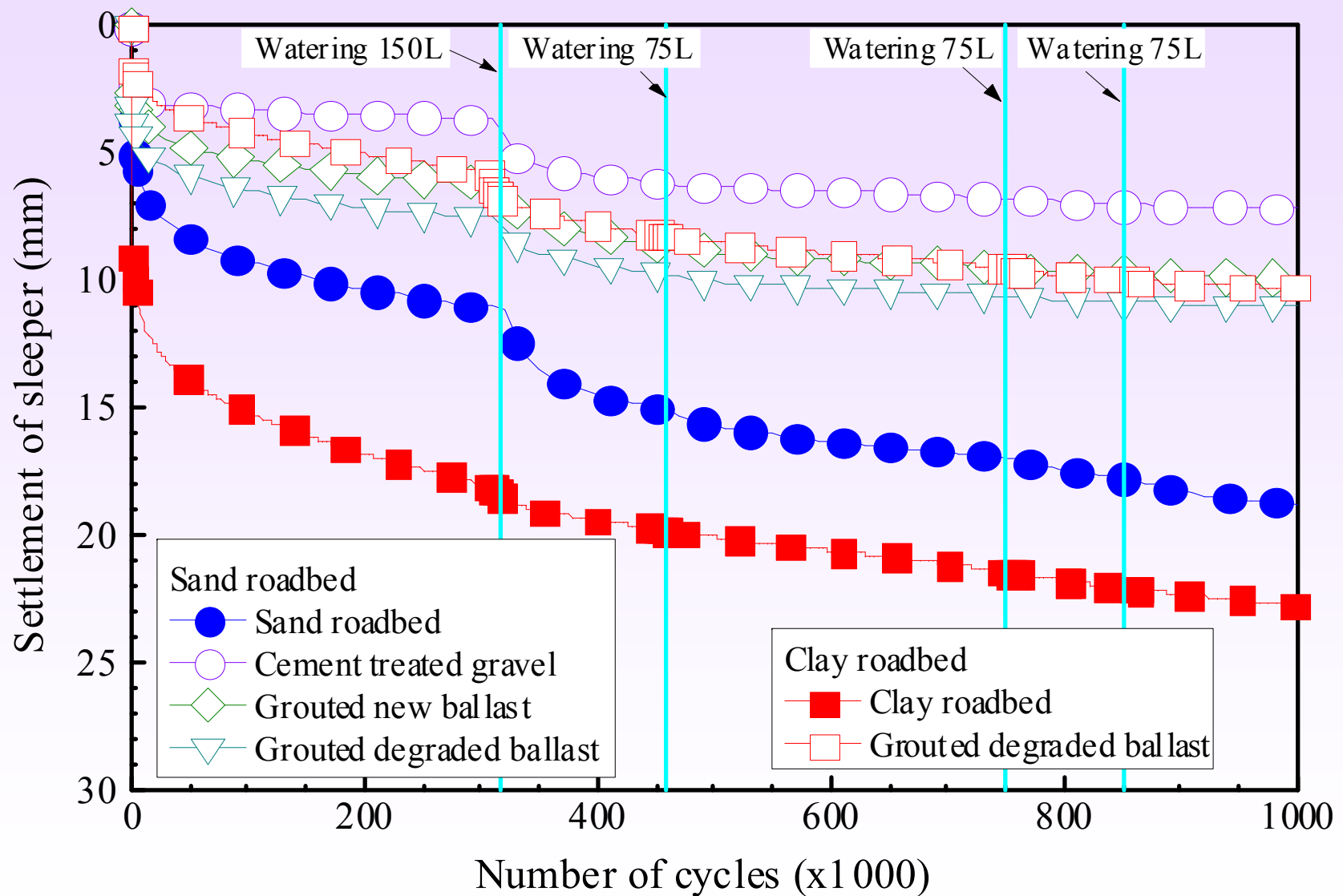
■ Test cases (Sand roadbed)



◆ Cyclic loading test



◆ Cyclic loading test results



Improvement of degraded ballast by polymer

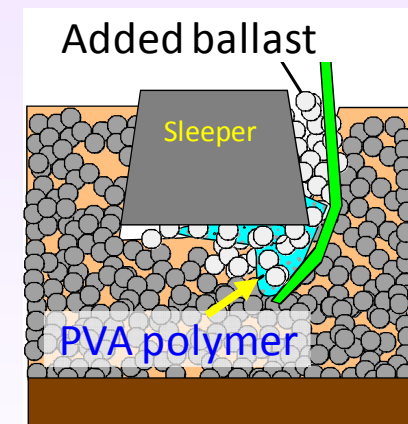
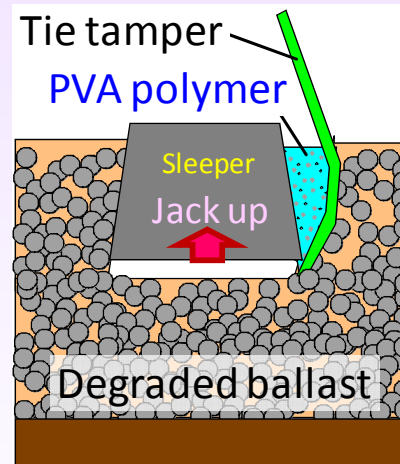
◆ Cost for roadbed improvement is still high.

➡ Improve shear strength of degraded ballast

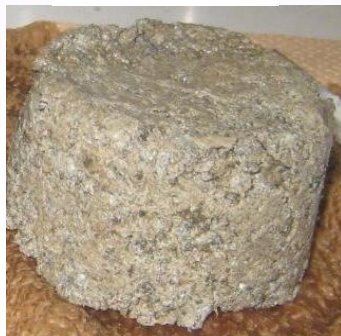
Polymer aqueous solution (PVA)



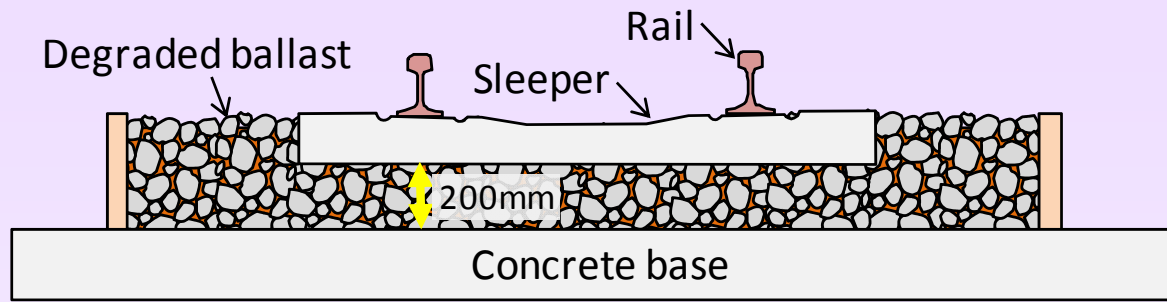
Reaction agent (Sodium silicate)



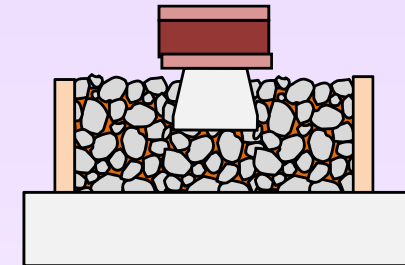
Treated soil



◆ Loading test condition

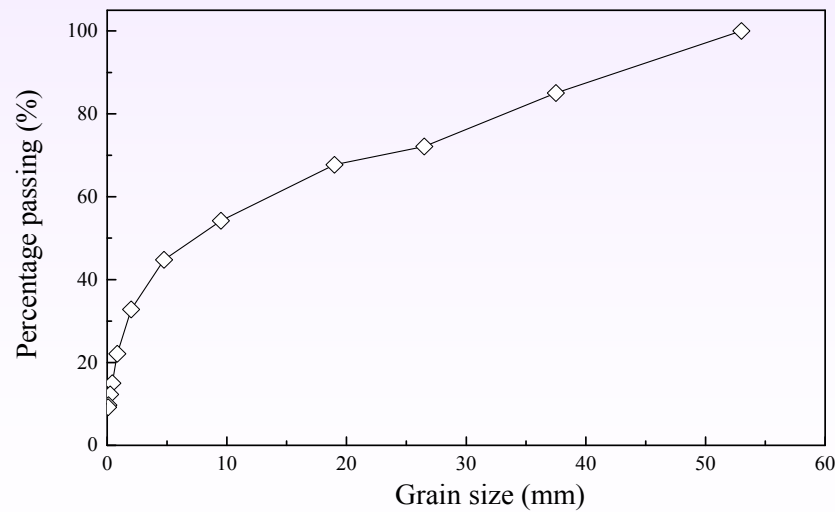


(a) Front view

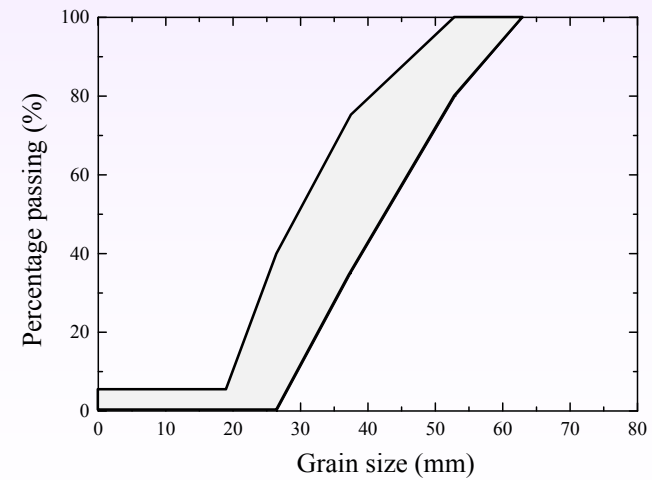


(b) Side view

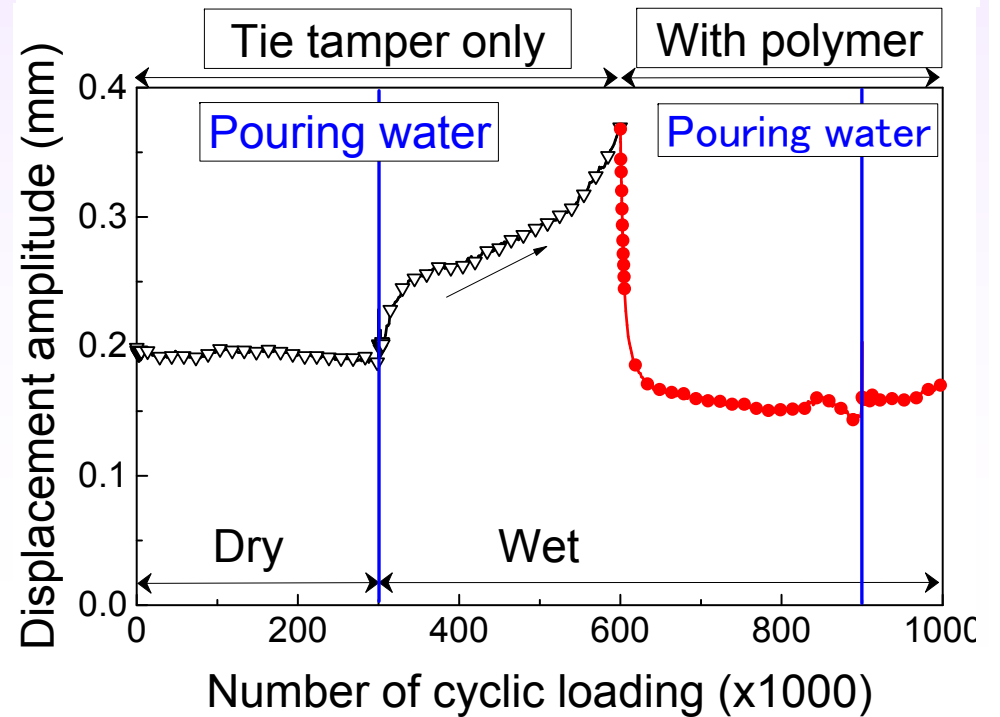
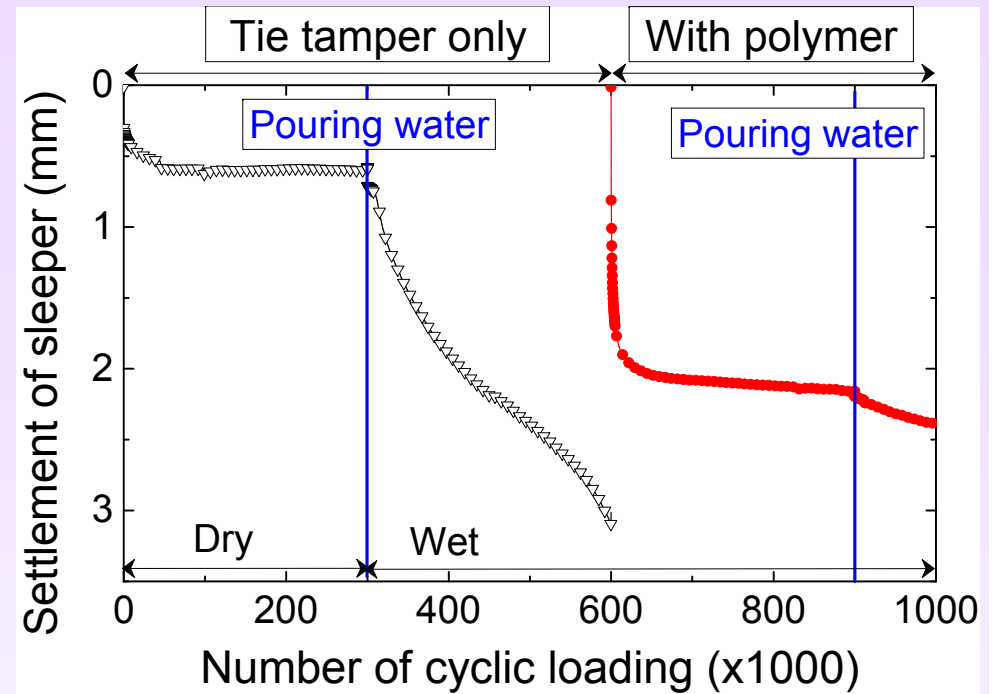
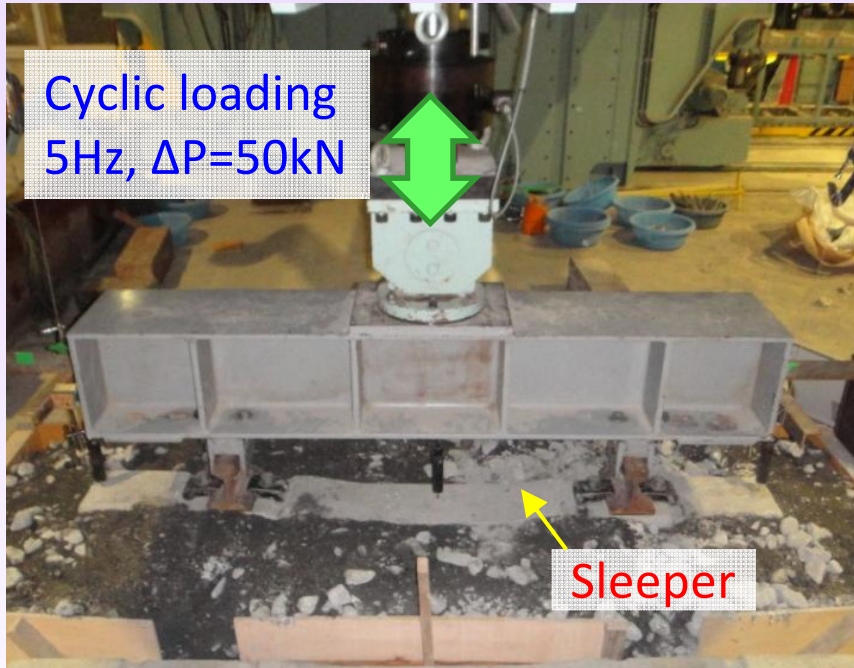
Grain size distribution of degraded ballast



Grain size distribution of new ballast



◆ Cyclic loading test



Conclusions

- Stability of the degraded ballast became much less under the saturated condition.
- Roadbed improvement with grout and degraded ballast effectively reduced the settlement of the sleeper.
- Polymer improvement effectively reduced the settlement of the sleeper.

