INFLUENCE OF INTERNAL EROSION ON DEFORMATION AND STRENGTH OF GAP-GRADED NON-COHESIVE SOIL

L. KE, PhD Candidate

A. TAKAHASHI, Associate Prof.

Department of Civil Engineering

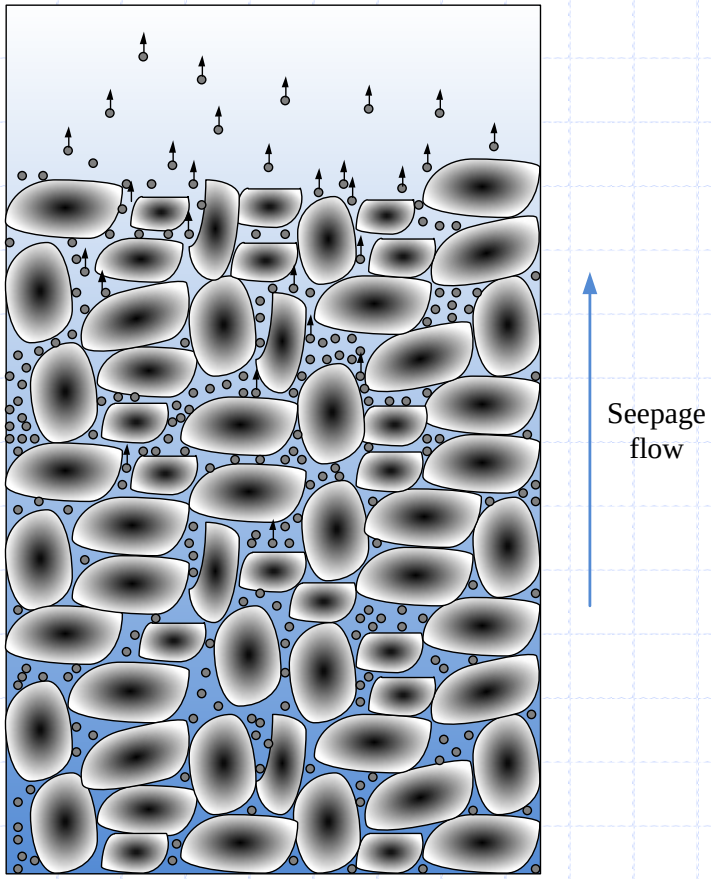
Tokyo Institute of Technology

August 30th 2012

Motivation

Suffusion

- The gradual migration of fine particles through a coarse matrix leaving the coarse skeleton alone.
- It cause changes in soil porosity and hydraulic conductivity.



Methodology

Experimentally evaluate the strength of cohesionless soil after suffusion

Experimental investigations

Upward seepage test:

create certain soil state induced by suffusion

Cone Penetration Test:

obtain the soil strength change by interpreting CPT data

Parametric study

Variable parameters:

Fine particle content

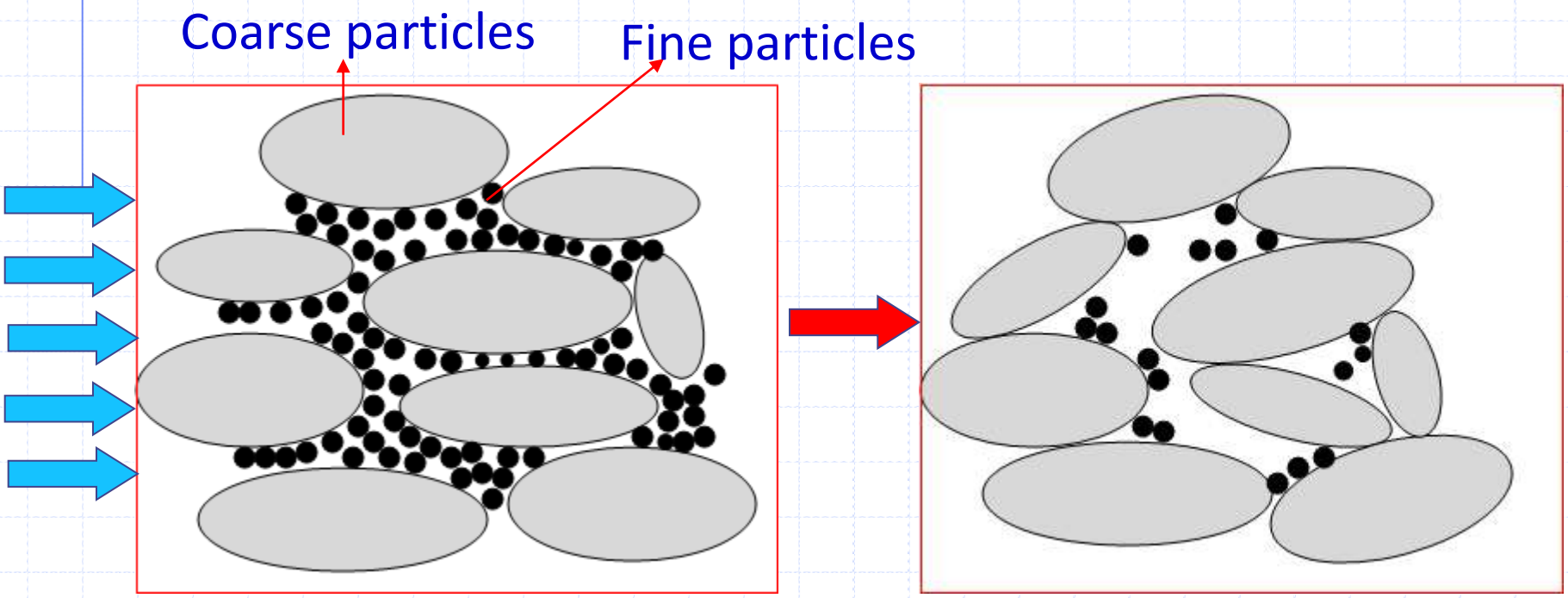
Maximum imposed hydraulic gradient

Certain relationship between hydraulic properties and strength of a soil specimen may exist

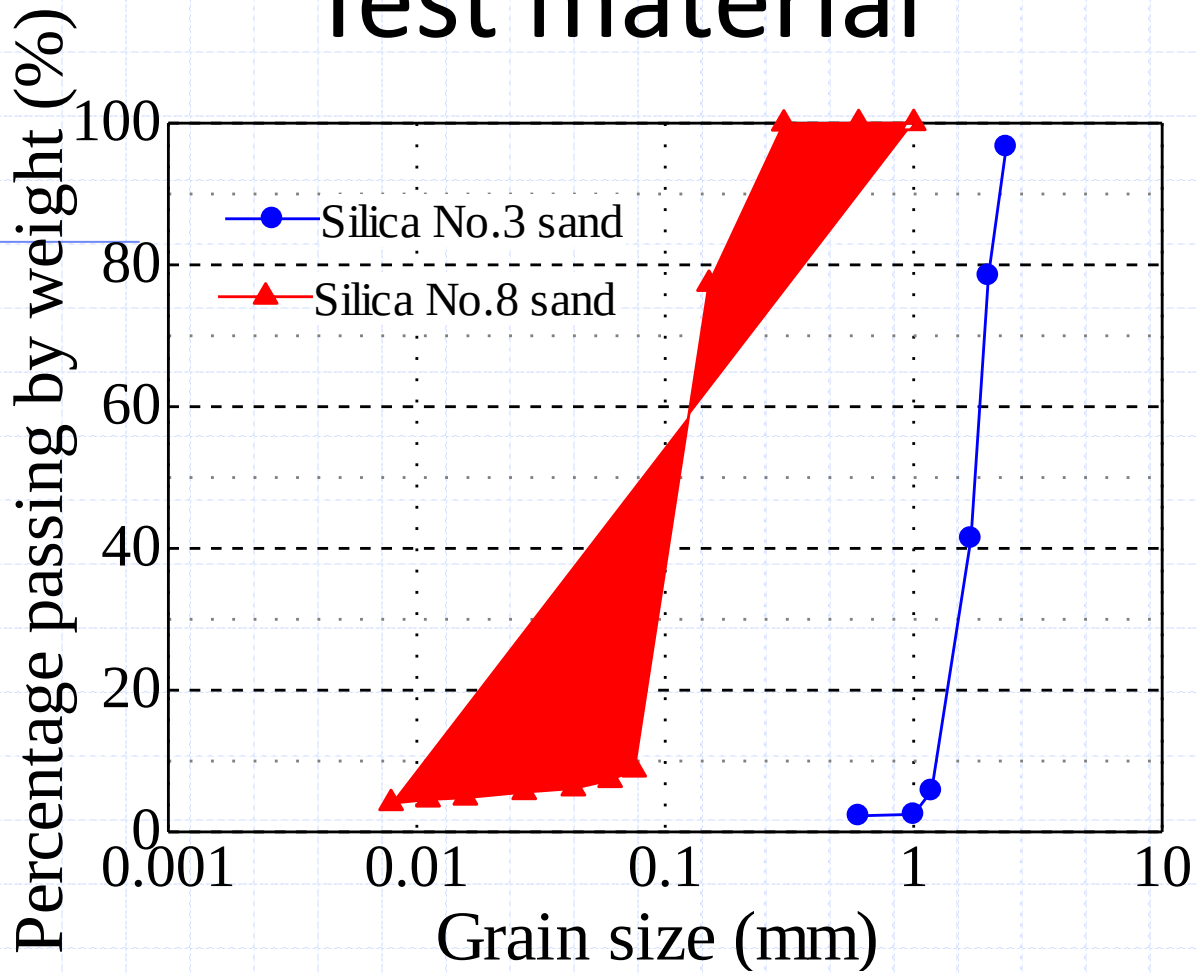
Motivation (Cont'd)

Influence on soil strength

Suffusion → Soil structure change → ? Soil strength change



Test material

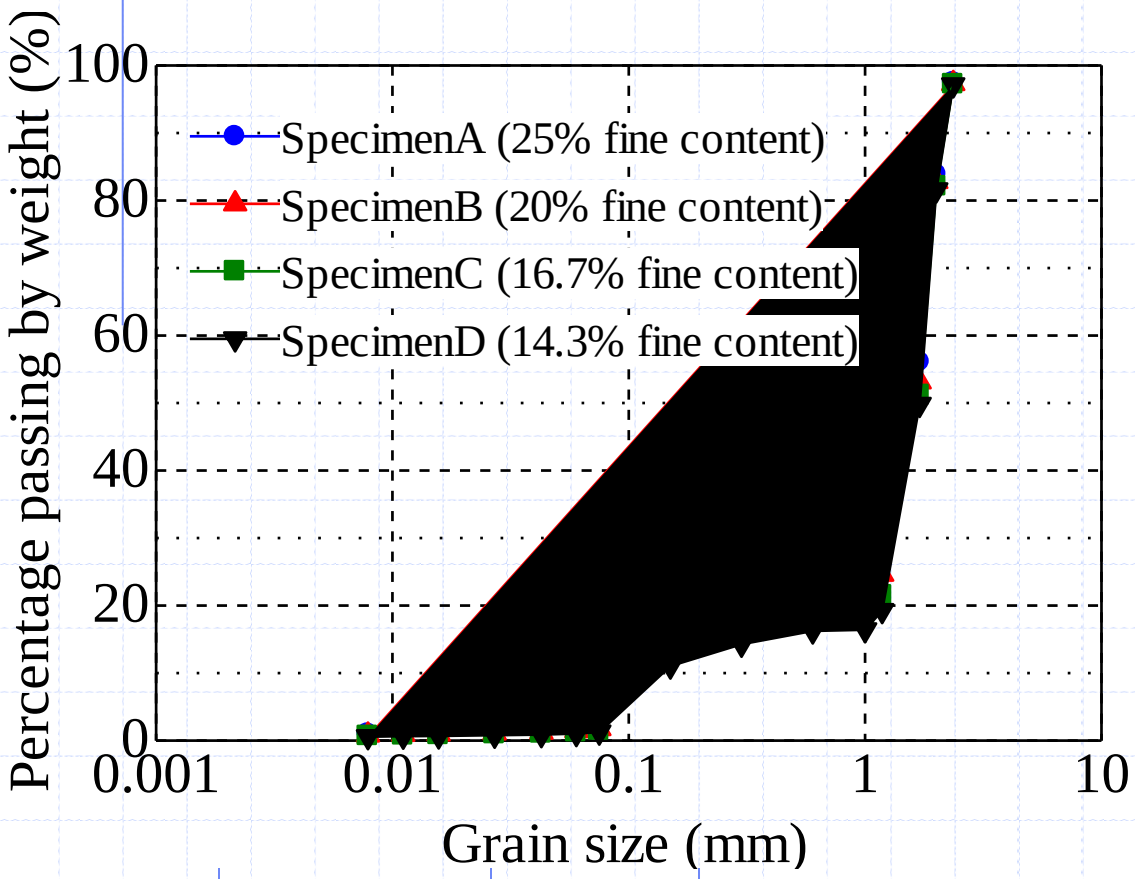


Silica No.3 is coarse material working as skeleton while Silica No.8 is fine material which could be washed away by seepage flow

Test specimens

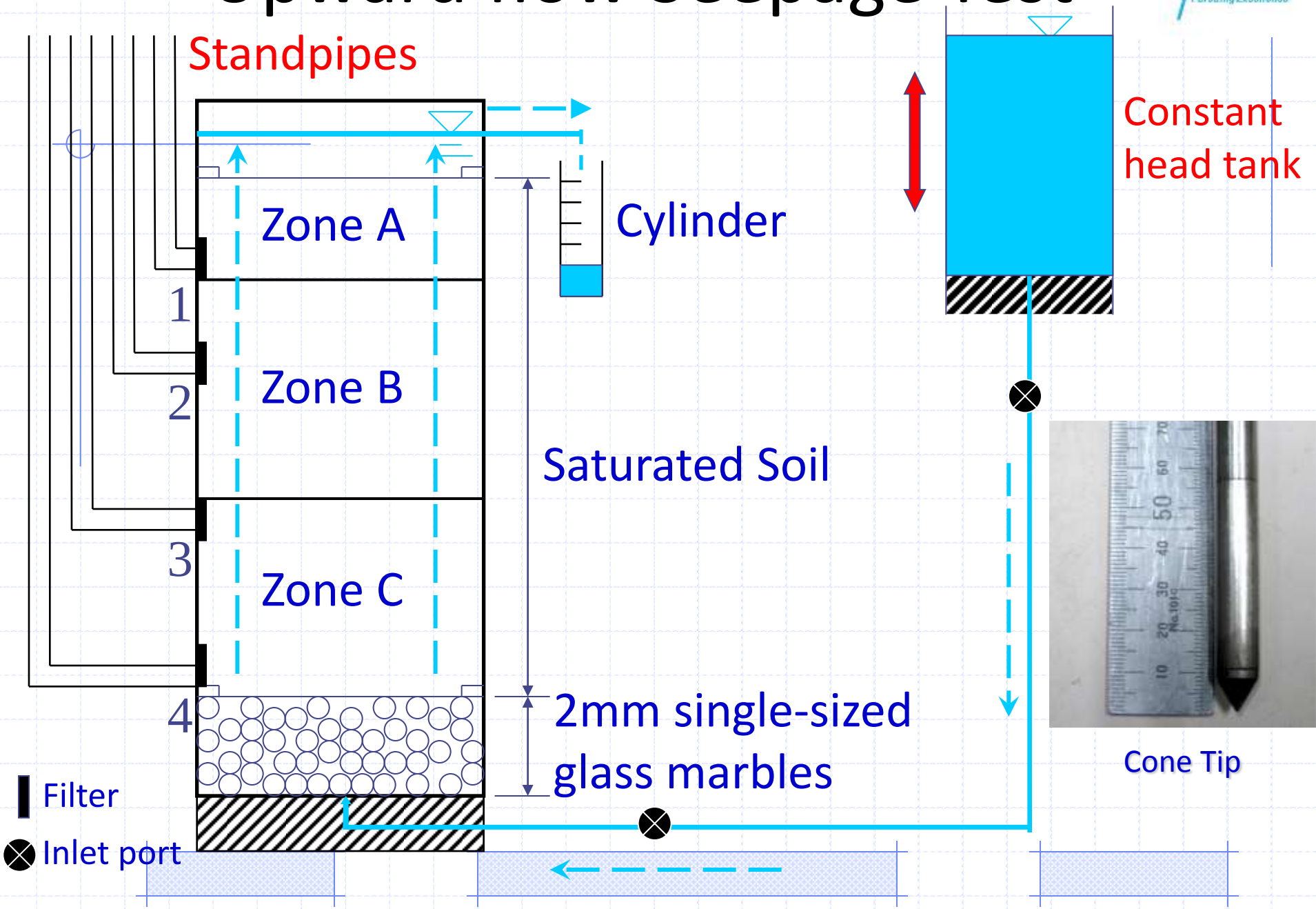
Fine content: 25%, 20%, 16.7% and 14.3%

Imposed hydraulic gradient: 0~0.5 (All specimens)

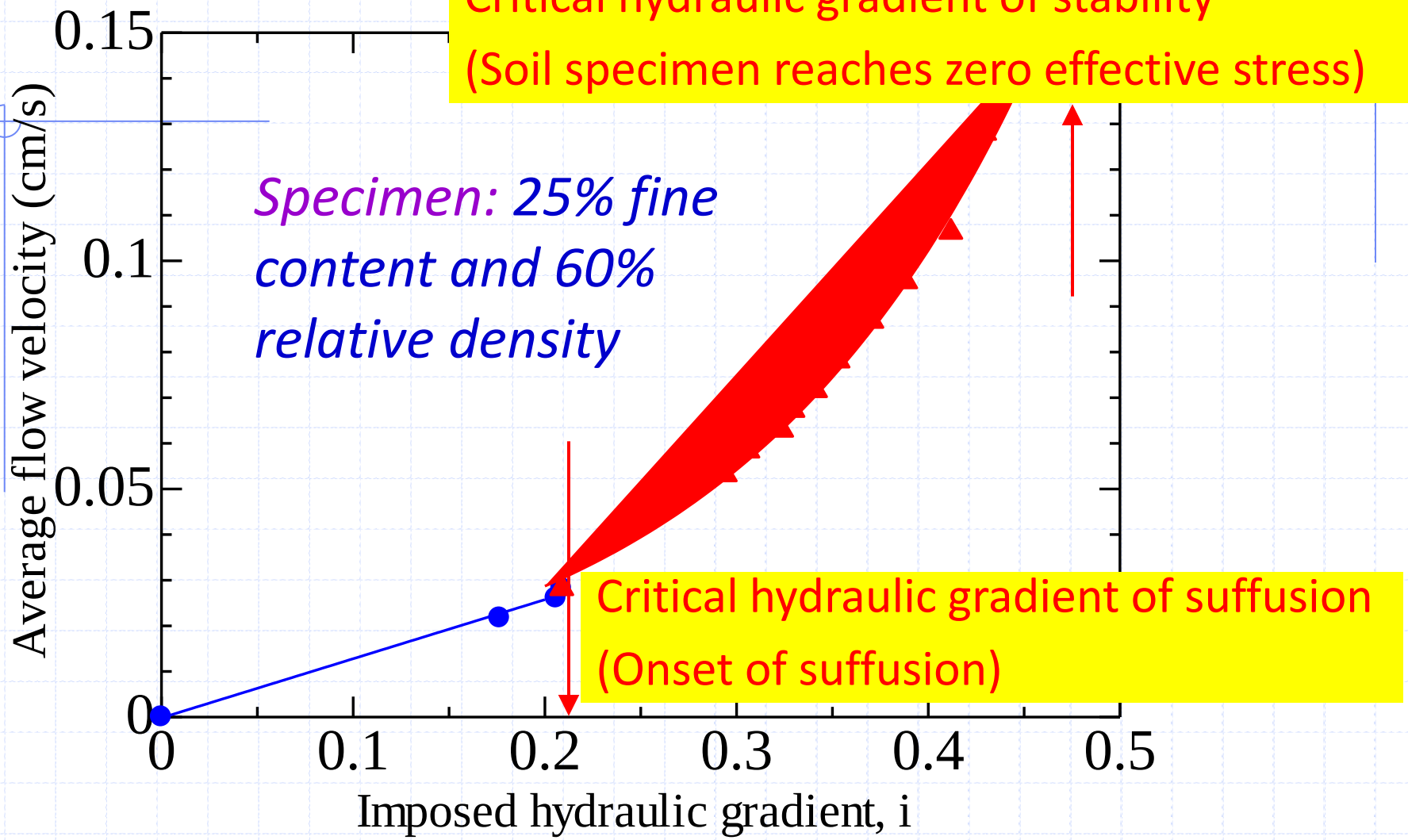


Tested specimen

Upward flow Seepage Test



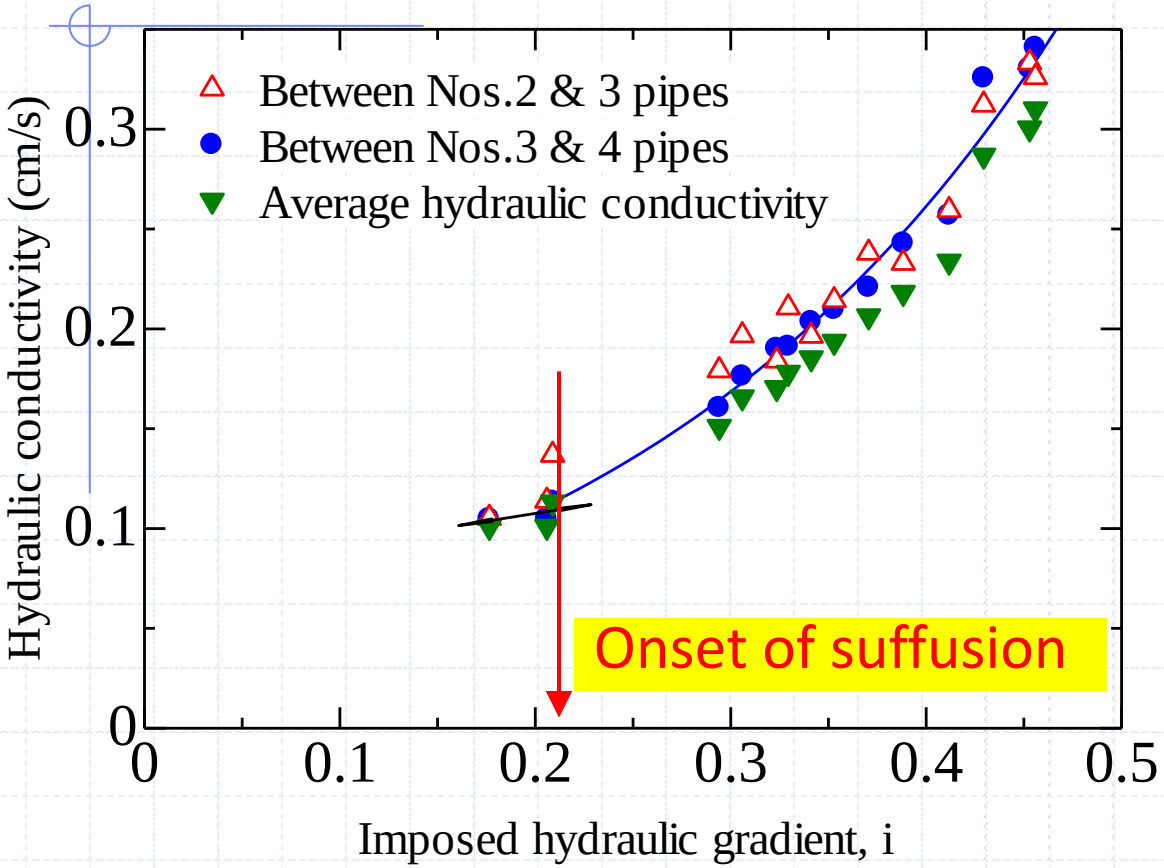
Seepage test results

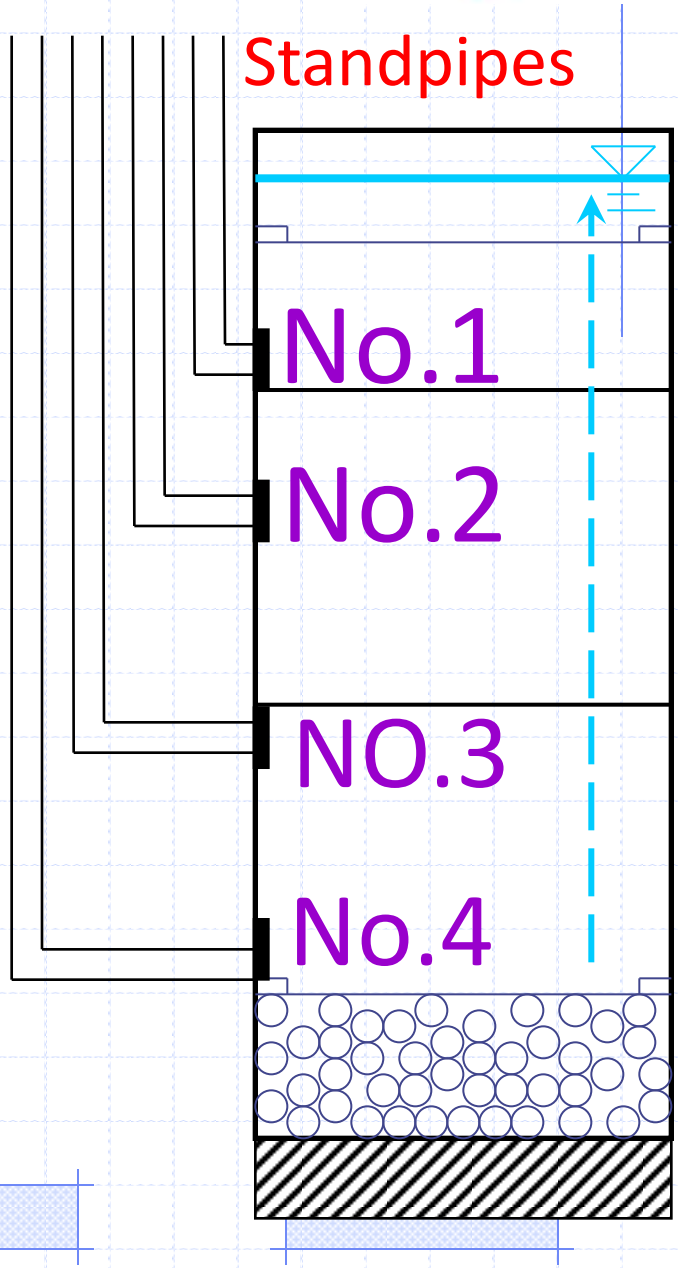


The hydraulic conductivity increases with the process of suffusion

Seepage test results

---Hydraulic conductivity





Specimen: 25% fine content and 60% relative density

Seepage test results

Fine particle migration (25% fine content; 60% relative density)

Before suffusion

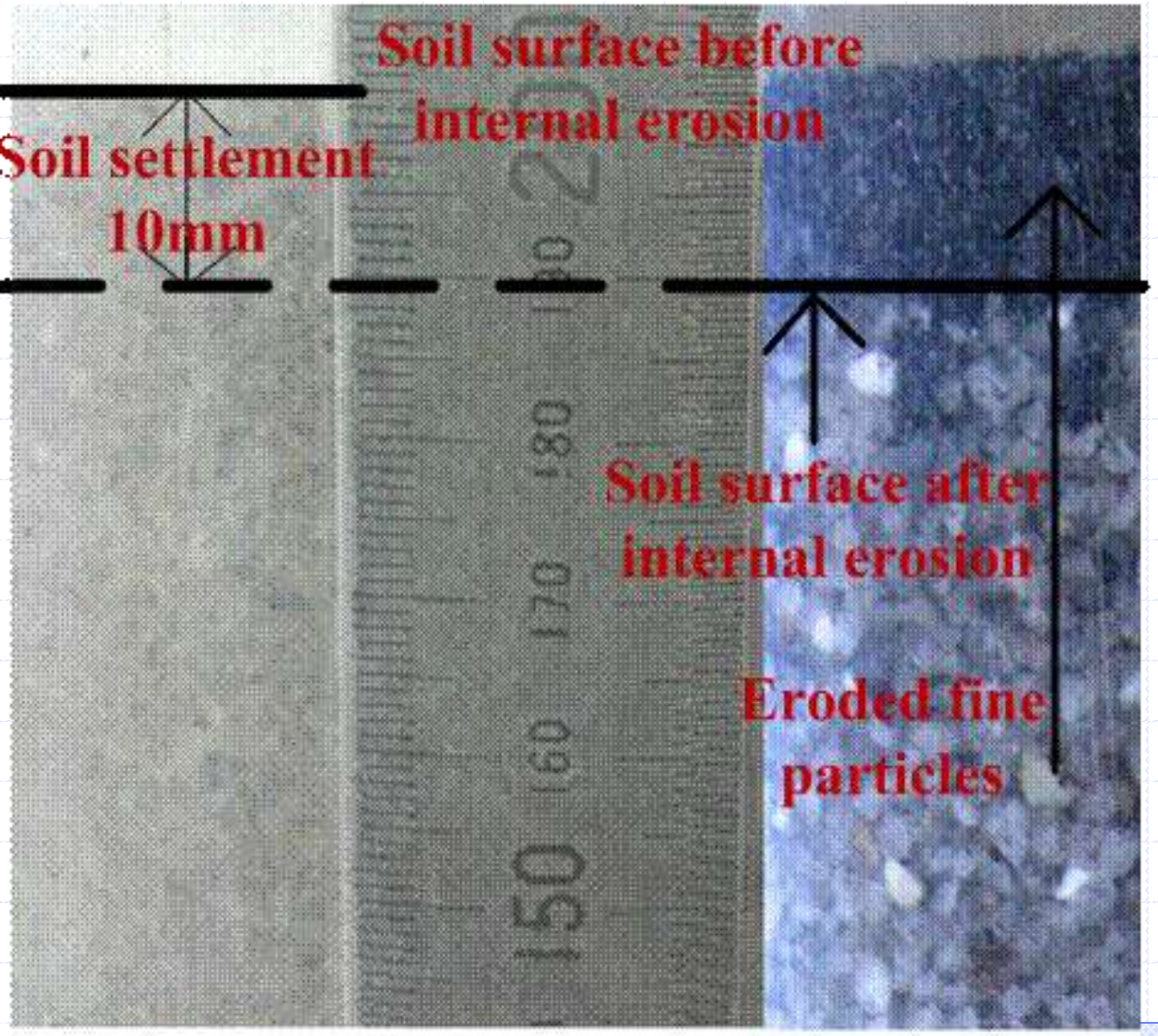
i=0.17

i=0.20

i=0.23

Seepage test results

Specimen void ratio and volume change



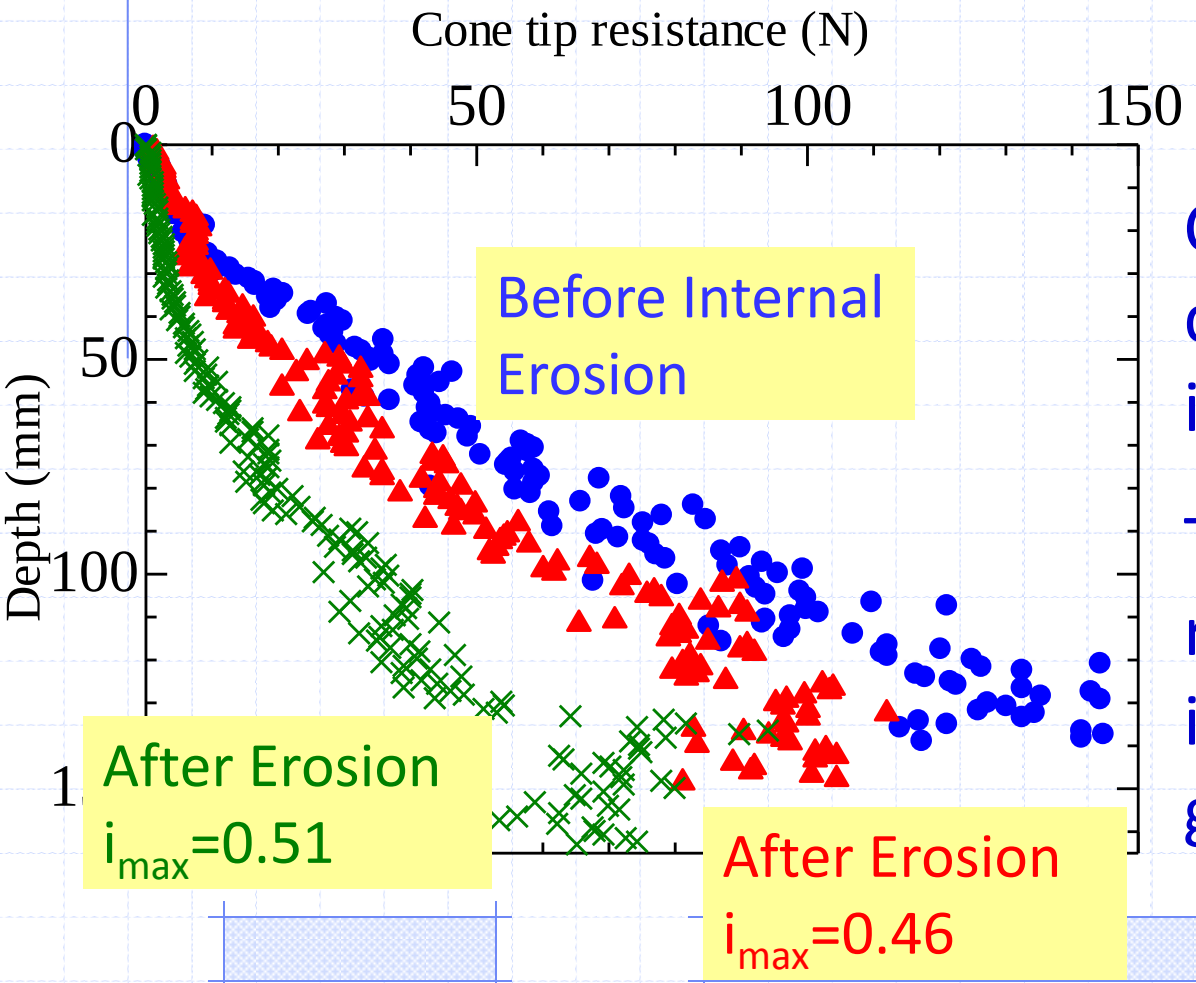
Specimen: 25% fine content, 60% relative density

By observation, the maximum settlement was approximately 10 mm, which is equal to 5.8% in volumetric strain

CPT Test results

---Influence of internal erosion on soil strength

Specimen: 25% fine content, 60% relative density



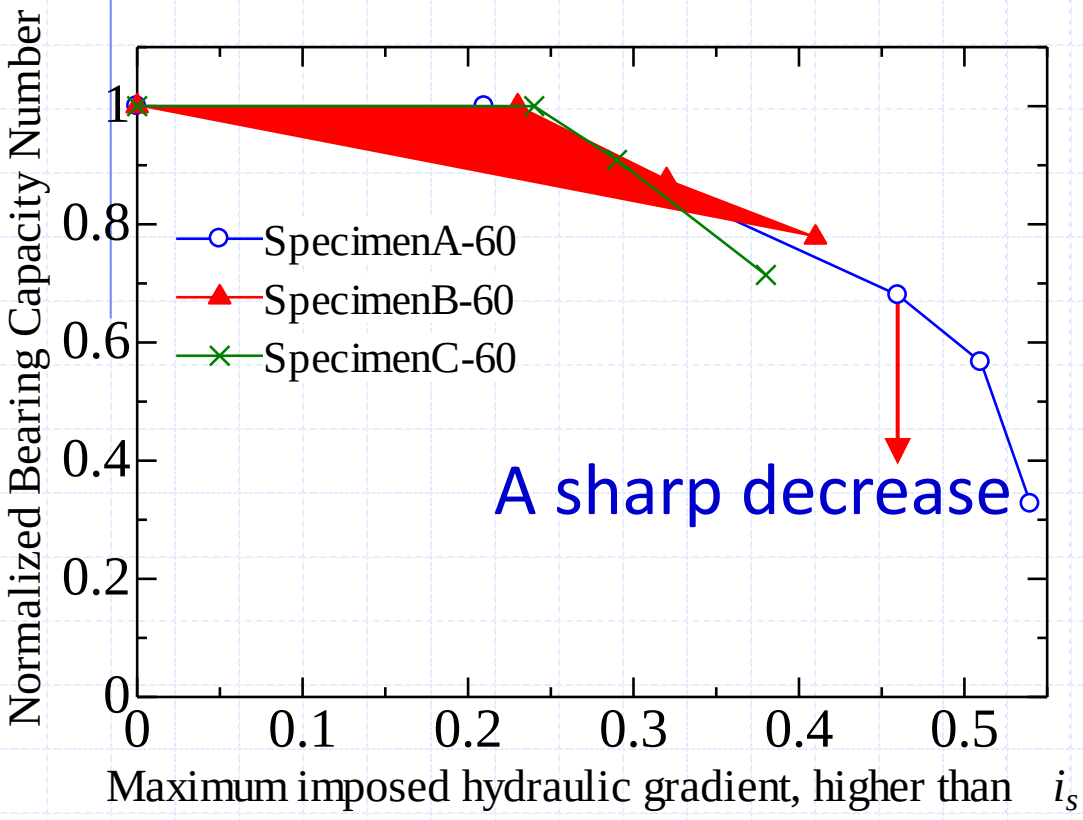
Cone tip resistance decreases on the internally eroded soil

The extent of decrease relates with the imposed hydraulic gradient

CPT test results

---Influence of internal erosion on soil strength

Bearing capacity number =Cone resistance/Vertical effective stress



Bearing capacity theory

Soil strength decrease with the imposed hydraulic gradient

Sample A-60 : 25% fine content, 60% relative density

Sample B-60 : 20% fine content, 60% relative density

Sample C-60 : 16% fine content, 60% relative density

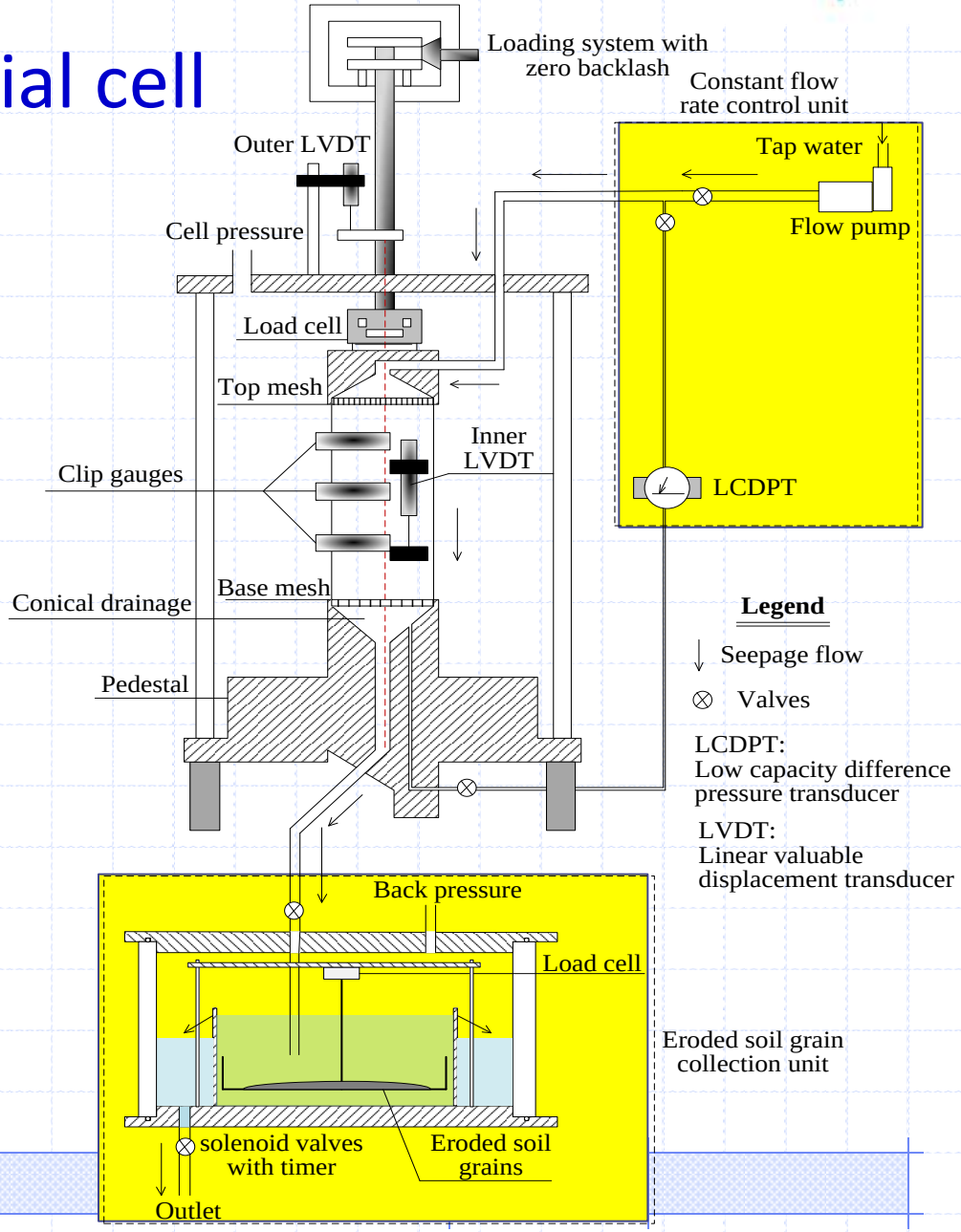
Triaxial Seepage Test

Seepage test in a Triaxial cell

Seepage flow test

Shear test

- Flexible wall
- Experiment with back pressure
- Conduct seepage test under various stress condition



Conclusions

- The hydraulic conductivity of soils drastically increases with progress of the internal erosion.
- The higher the maximum assigned hydraulic gradient, the higher the fine particle loss.
- Suffusion would cause the soil strength reduction, the extent of which relates with the imposed hydraulic gradient.

Thank you for your attention