

VACUUM PRELOADING:

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Pengenalan

- Metode Vacuum Preload efektif untuk perbaikan tanah lempung sangat lunak dimana aplikasi beban surcharge sukar untuk dilaksanakan.
- Metode vacuum preloading lebih murah dan lebih cepat pelaksanaannya.
- Perbedaan utama dengan surcharge preloading adalah pada perubahan tekanan air pori

Kriteria Disain

The degree of consolidation (DOC) is usually used as one of the criteria for assessing the effectiveness of soil improvement work using the fill surcharge or vacuum preloading method.

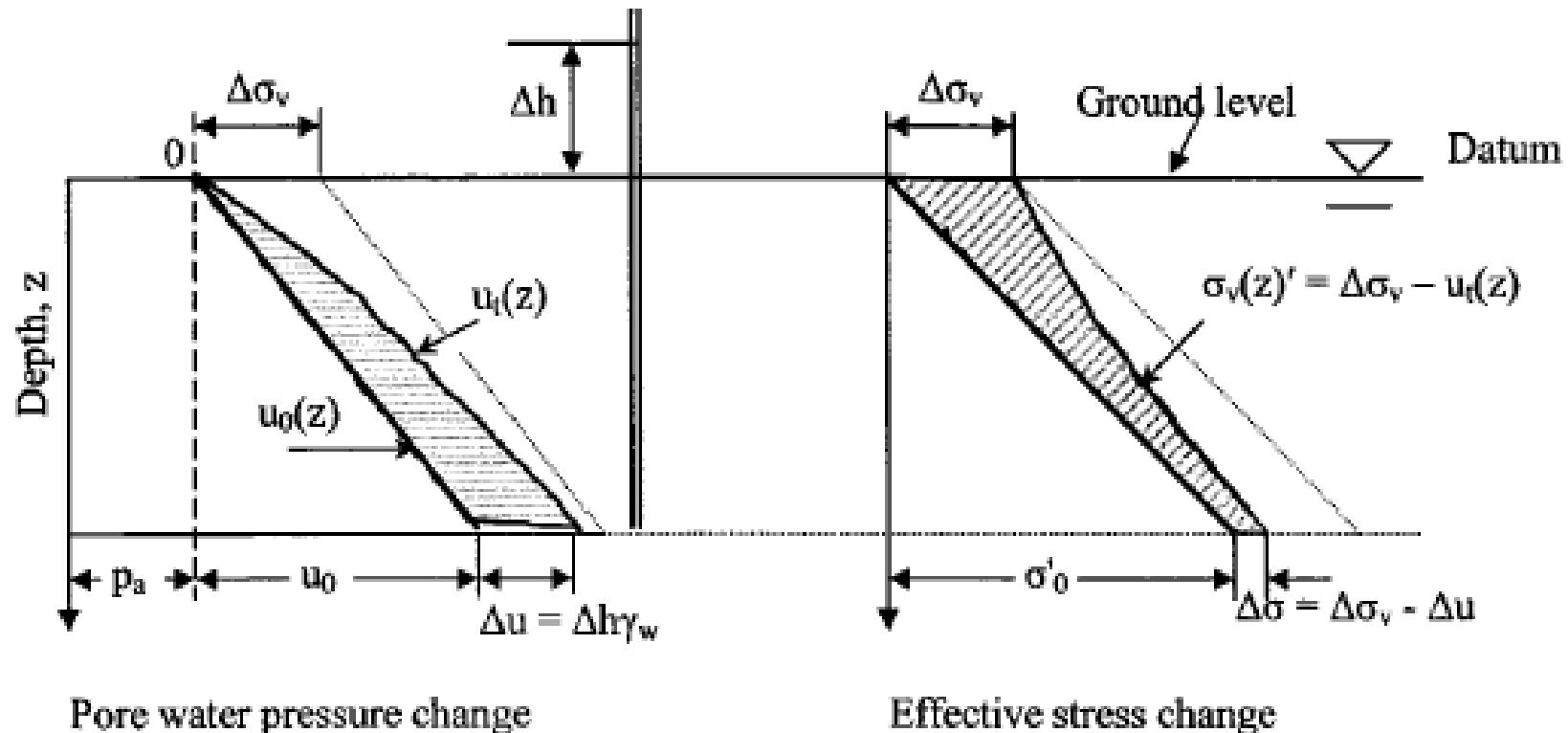
Degree of consolidation is often used as a design specification in a soil improvement contract.

Perbedaan antara Vacuum dan Surcharge Preloading

Under fill surcharge the excess pore water pressure ($+\Delta\mu_e$) will first build up from its initial (normally hydrostatic) state by the same amount as the surcharge and then dissipate gradually.

Under vacuum pressure, the pore water pressure in the soil will reduce from its initial (normally hydrostatic) state by the same amount as the applied vacuum pressure ($-\Delta\mu_e$)

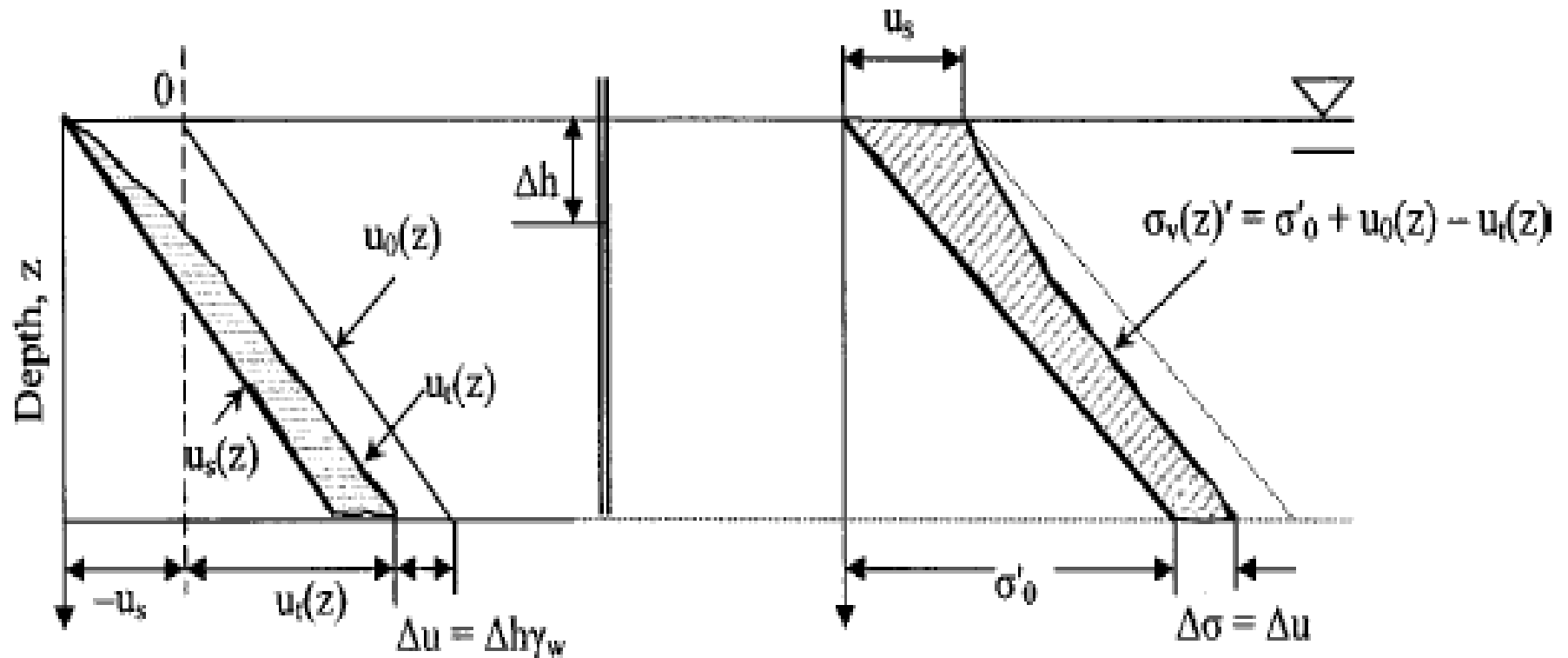
Diagram tekanan efektif dan tekanan air pori pada kasus surcharge preloading



$u_0(z)$ = hydrostatic pore water pressure profile
 $u_1(z)$ = excess pore water pressure at time t
 σ'_0 = initial effective overburden stress

$\sigma_v(z)'$ = effective stress at time t
 $u_s(z)$ = suction line

Diagram tekanan efektif dan tekanan air pori pada kasus vacuum preloading



Pore water pressure change

Effective stress change

$u_0(z)$ = hydrostatic pore water pressure profile

$\sigma_v(z)'$ = effective stress at time t

$u_t(z)$ = excess pore water pressure at time t

$u_s(z)$ = suction line

σ'_0 = initial effective overburden stress

Interpretation of Piezometer Reading for surcharge preloading

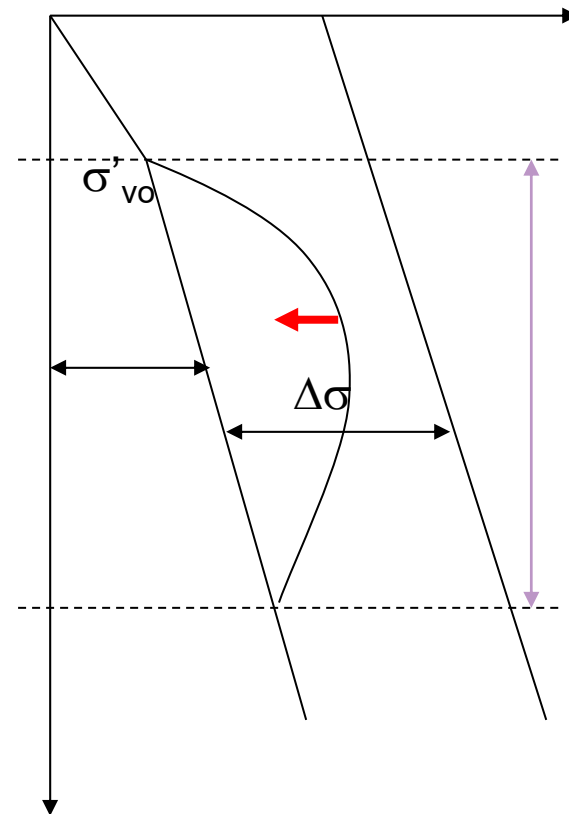
- The degree of consolidation based on pore water pressure can be calculated as :

- $$U_{avg} = 1 - (u_t/u_i)$$

where

u_t = average excess pore pressure at time t

u_i = initial excess pore pressure



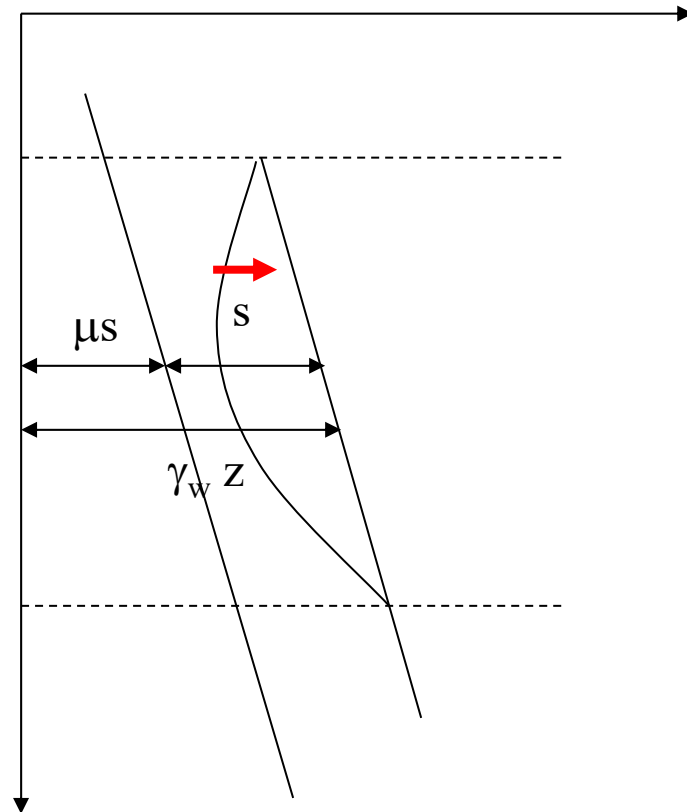
Interpretation of Piezometer Reading for vacuum preloading

- ⦿ The degree of consolidation based on pore water pressure can be calculated as :

$$U_{avg} = 1 - \frac{\int [u_t(z) - u_s(z)] dz}{\int [u_0(z) - u_s(z)] dz}$$

where

$$u_s(z) = \gamma_w z - s(kpa)$$



Menentukan derajat konsolidasi berdasarkan settlement

The degree of consolidation based on settlement is normally calculated as the ratio of the current settlement to the ultimate settlement .

The Asaoka's (1978) method is selected to calculate ultimate settlement and the settlement at any time t .

Metode ini berdasarkan penurunan settlement dengan settlement plate

Menentukan derajat konsolidasi berdasarkan tekanan air pori (diukur dengan piezometer)

The degree of consolidation based on pore water pressure can be calculated as :

$$U_{avg} = 1 - \frac{\int [u_t(z) - u_s(z)] dz}{\int [u_0(z) - u_s(z)] dz}$$

where

$$u_s(z) = \gamma_w z - s, (kpa)$$

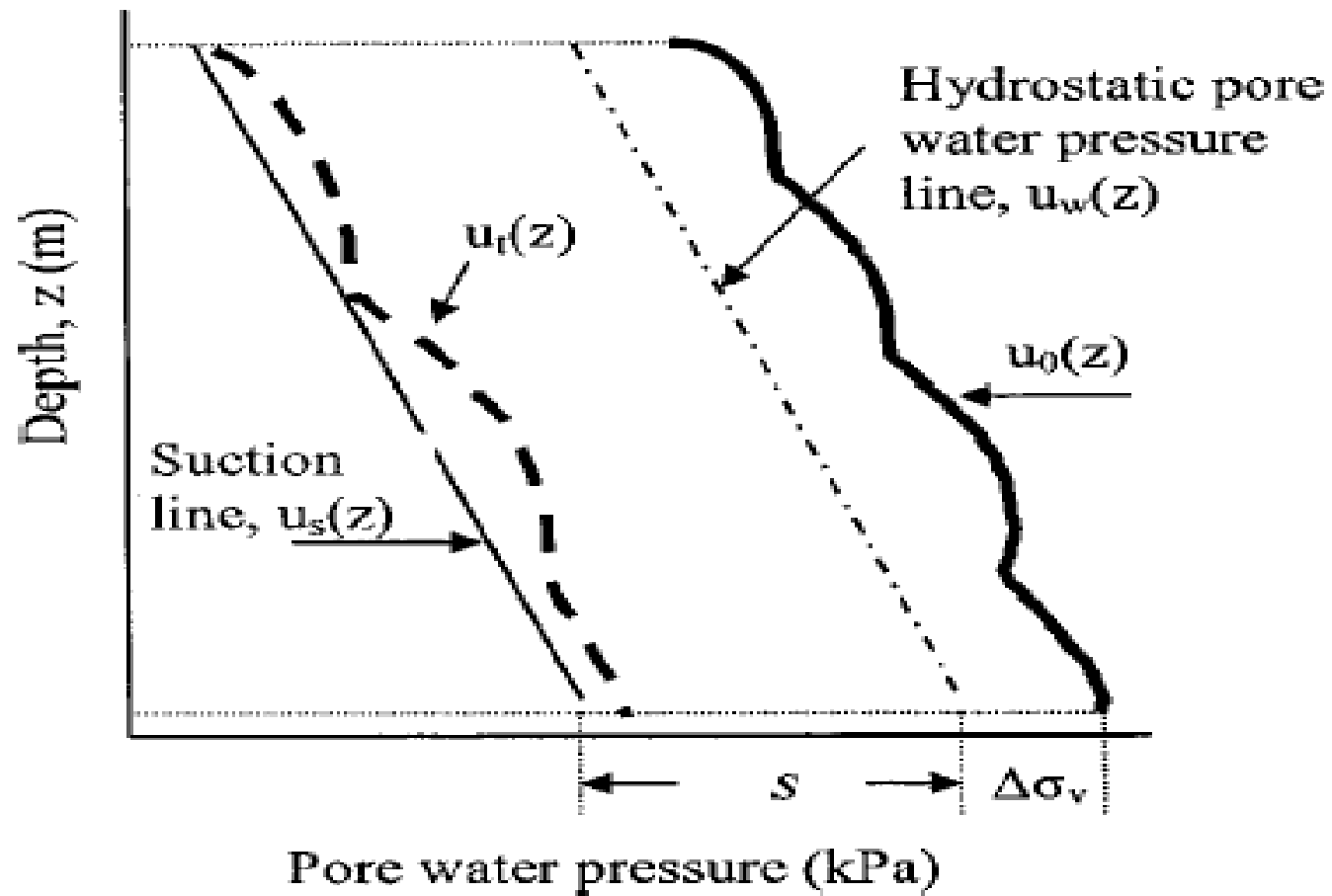
Perbandingan antara metode estimasi derajat konsolidasi berdasarkan settlement & berdasarkan tekanan air pori

The Degree of consolidation calculated using pore water pressure relies only on field pore water pressure data, whereas when calculating the DOC using settlement data, the ultimate settlement has to be predicted .

Not only the final DOC, but also the DOC at any time can be calculated

For consolidation involving multiple layers, calculation of DOC can be applied to any single layer to calculate the DOC achieved in a particular layer. It is not easy to calculate the DOC for each layer for multilayer soils using settlement.

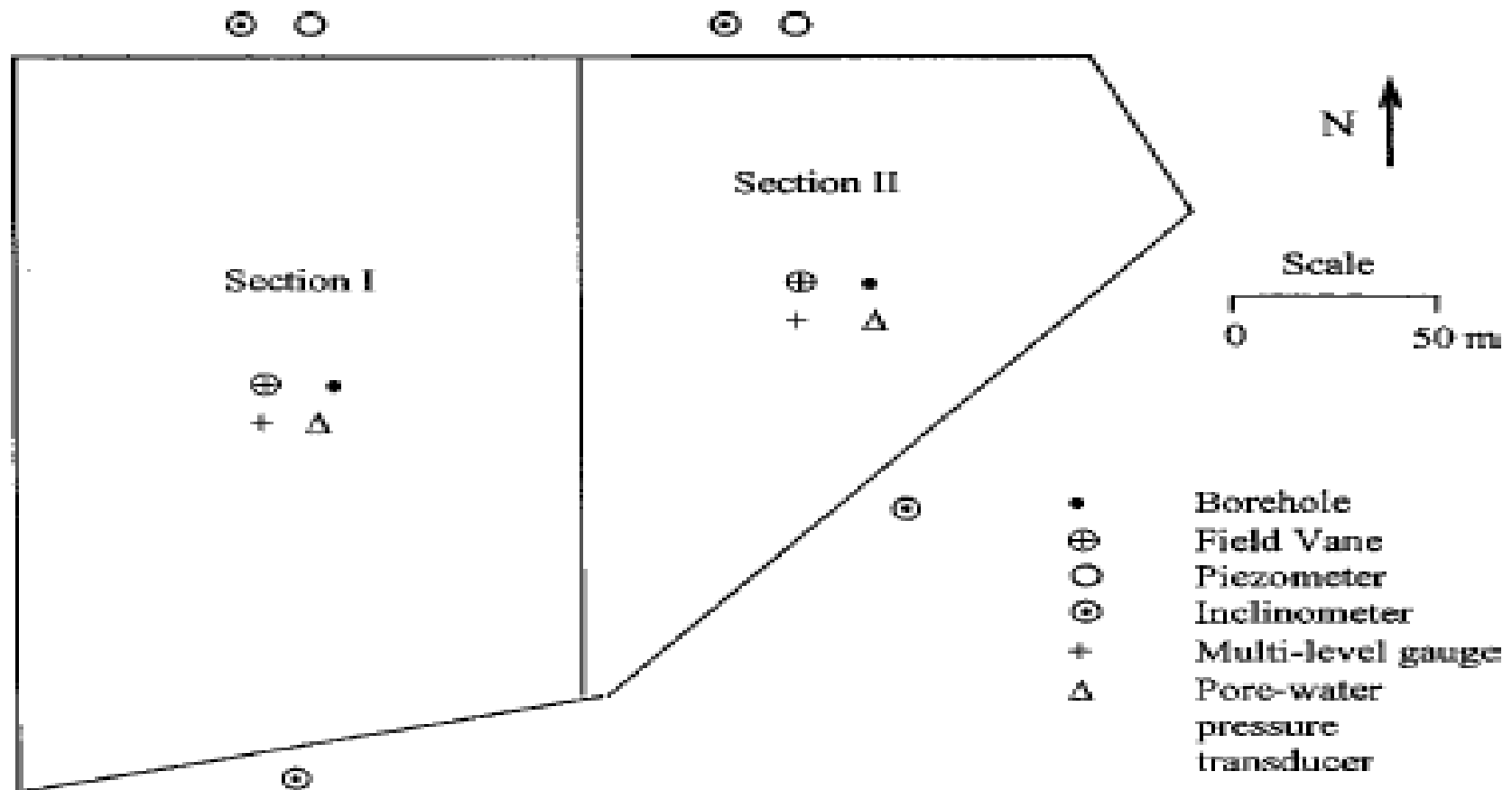
Actual pore water pressure distribution in soil



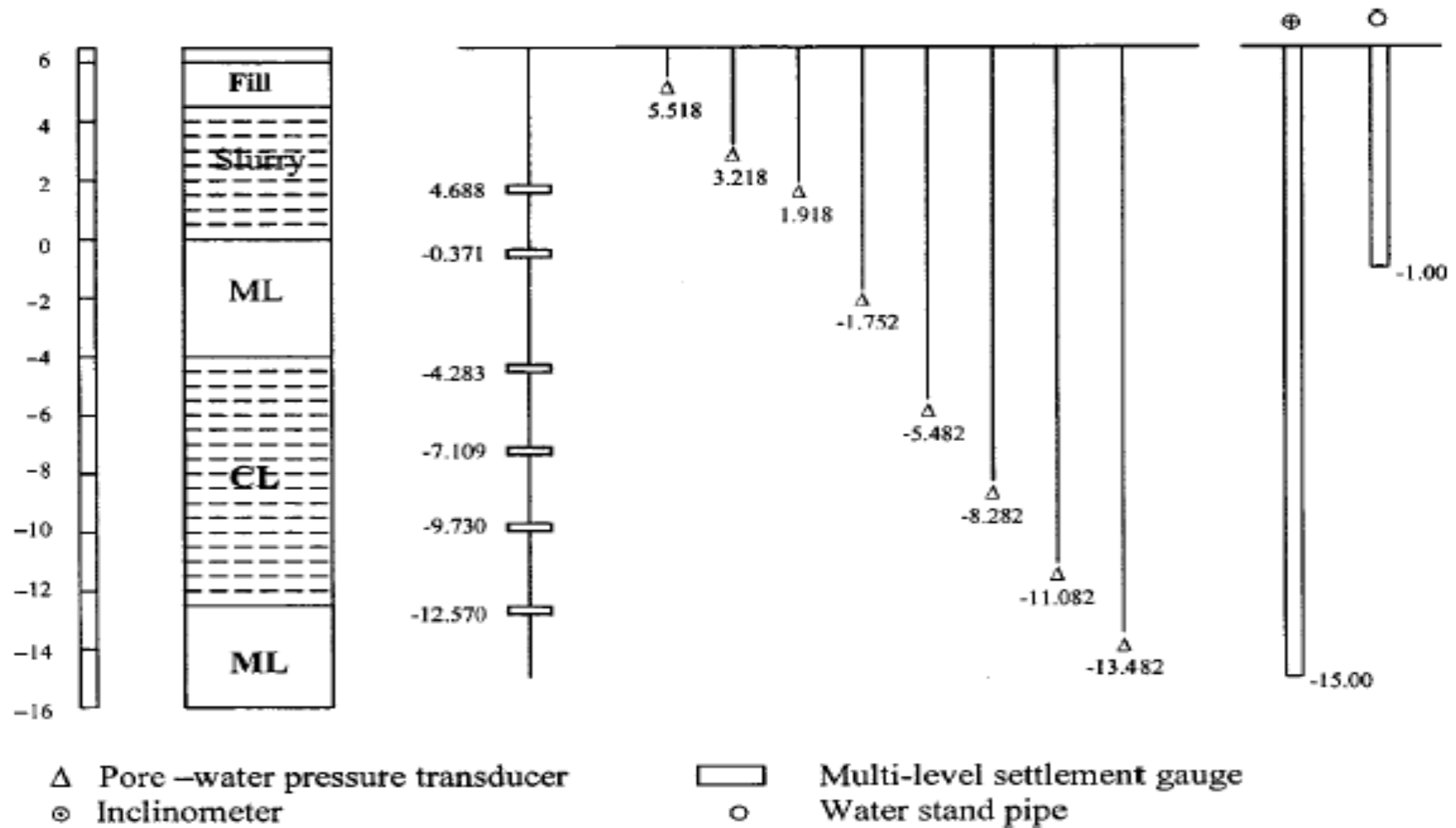
CONTOH KASUS: Oil Storage Station

Lokasi dan Lay out

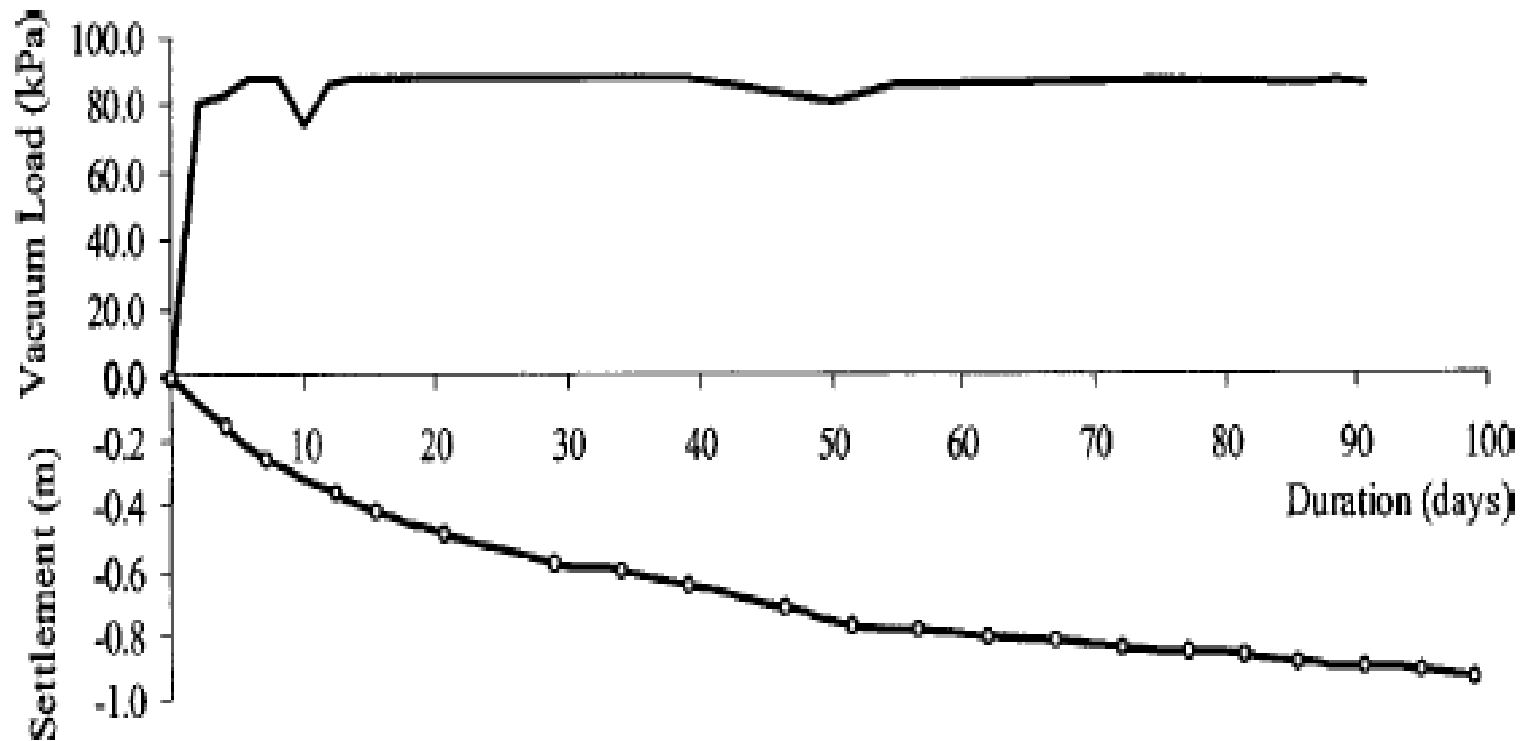
A vacuum pressure of 80 kpa was applied continuously for 125–145 days.



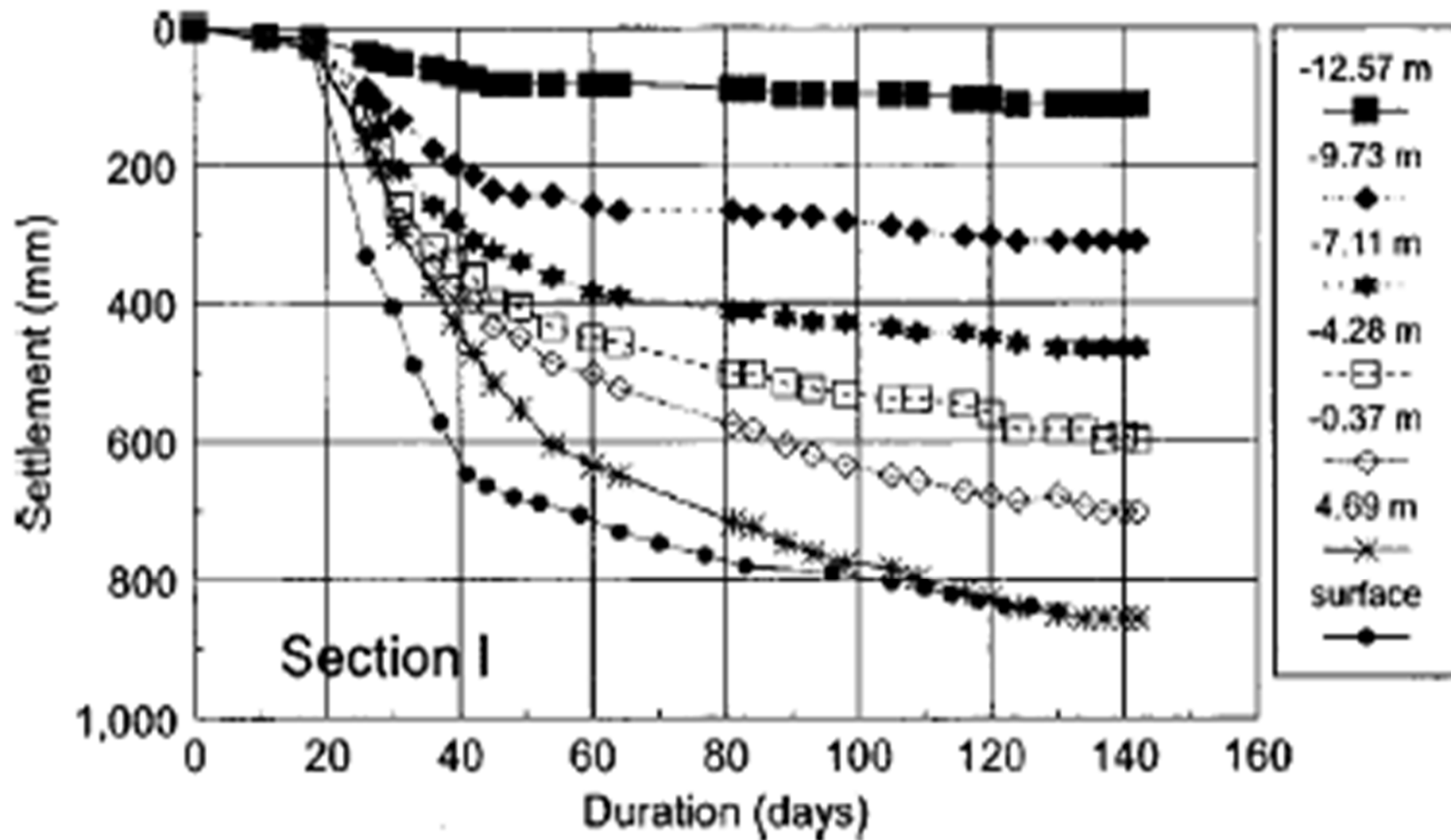
Kondisi Tanah dan Penempatan instrumen



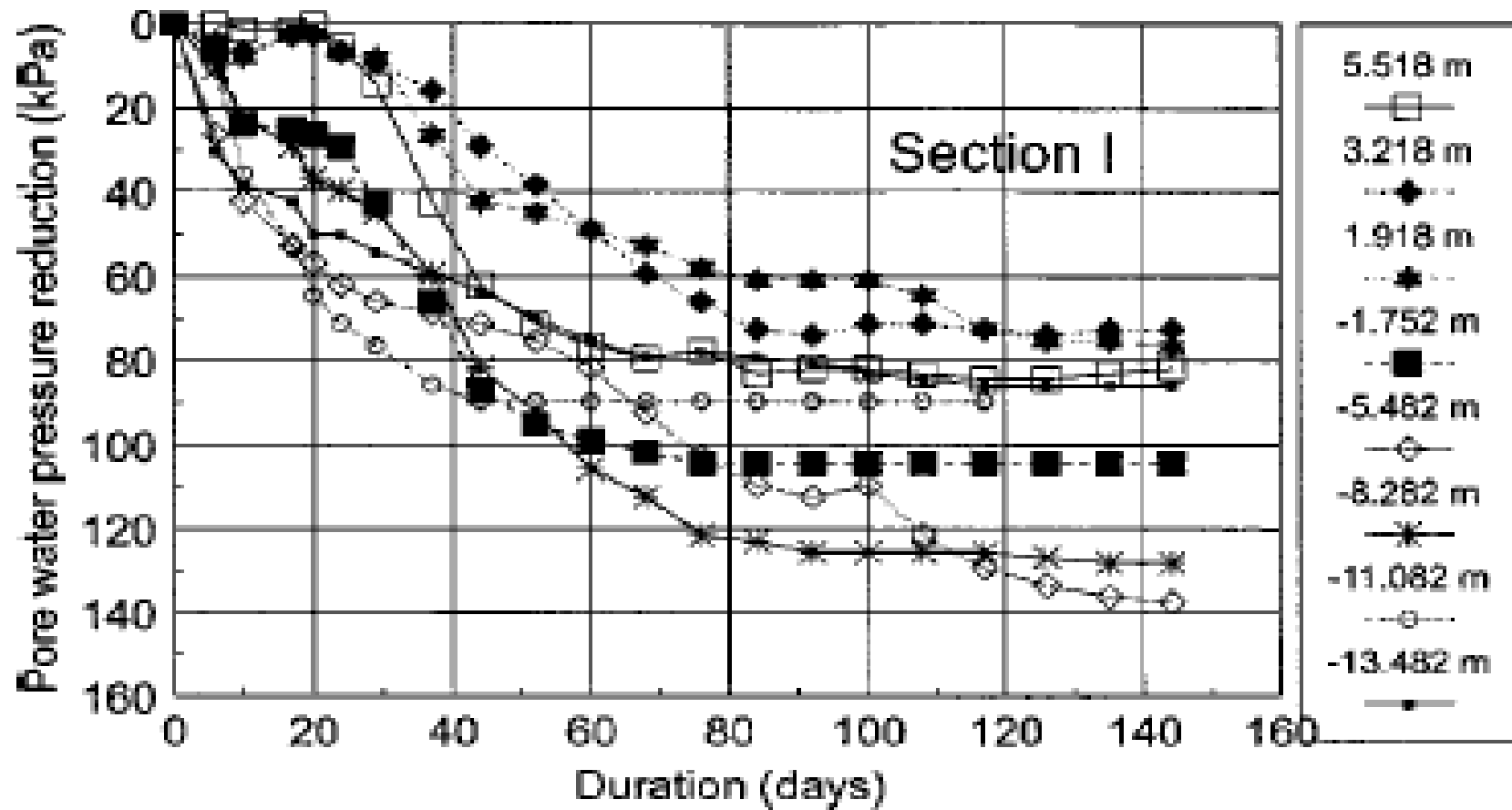
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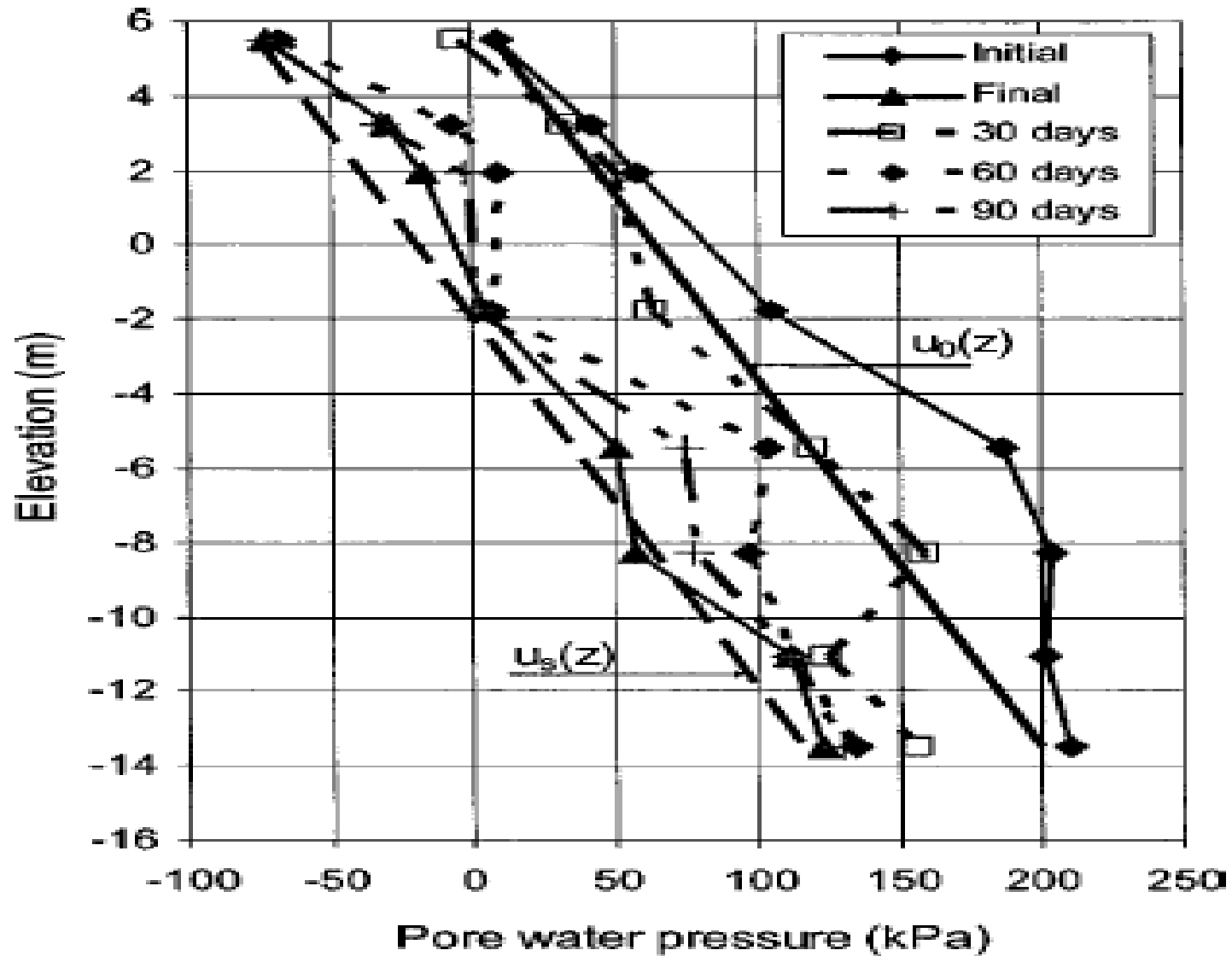
Plot penurunan terhadap kedalaman tanah
(settlement plate)



Pengurangan tekanan air pori selama aplikasi beban vacuum (piezometer)



Distribusi Tekanan air pori pada waktu $t =$



Kesimpulan

As settlement or pore water pressure data are required to assess the DOC, **field instrumentation and monitoring are essential for vacuum preloading projects.**

Using the monitored pore water pressure data, **the pore water pressure distribution versus depth profiles can be plotted for the initial, final, and any intermediate states .**

the DOC estimated using settlement data is generally greater than that using pore water pressure data. This can be partially explained by the fact that when only limited instruments can be used .

settlement and pore water pressure gauges will be installed only at the locations where the maximum settlement and pore water pressure will be likely to occur.

As a result, the DOC tends to be overestimated when settlement data are used and underestimated when pore water pressure data are used.

For contracting purpose, it is necessary to specify the method used to calculate the DOC and indicate clearly whether the DOC is to be estimated using settlement or pore water pressure data.



<https://www.youtube.com/watch?v=XQ1cvEN5T5A>



Thank you

