MECHANICAL BEHAVIOR OF MARGINALLY FROZEN SOIL

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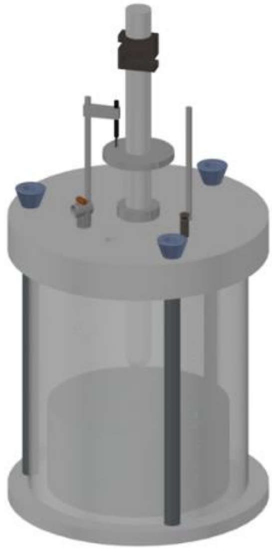
Theme 2 - M.Sc. project

Creep of embankments built on thaw-sensitive permafrost is usually attributed to static load.

OBJECTIVE

Quantify the effect of repeated loading on the behavior of marginally frozen soils.

METHODOLOGY



Samples

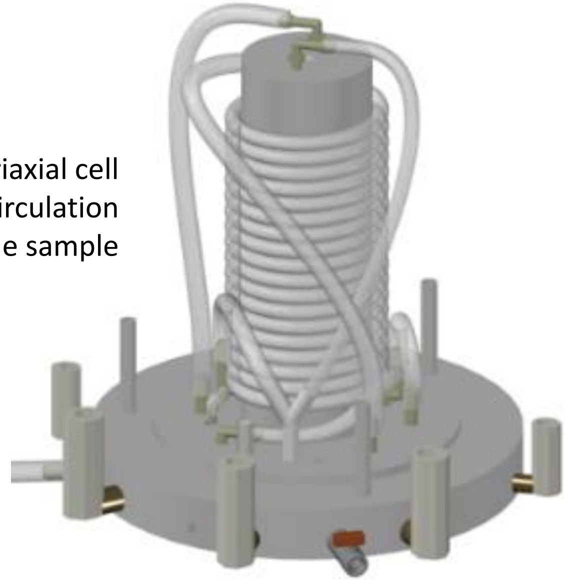
- Reconstituted in laboratory
- 28% sand, 72% fine
- w = 50% = 1,8 WL
- $S_R \approx 100\%$

Modified triaxial cell

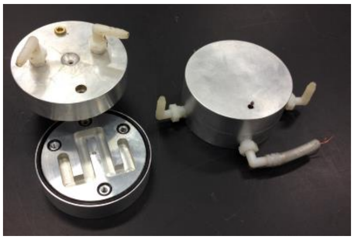
- -Precise control of temperature all around the sample : top, bottom, center (outside and inside the sample)
- -Independent control of temperature at 3 positions
- -Drainage of unfrozen water

Load

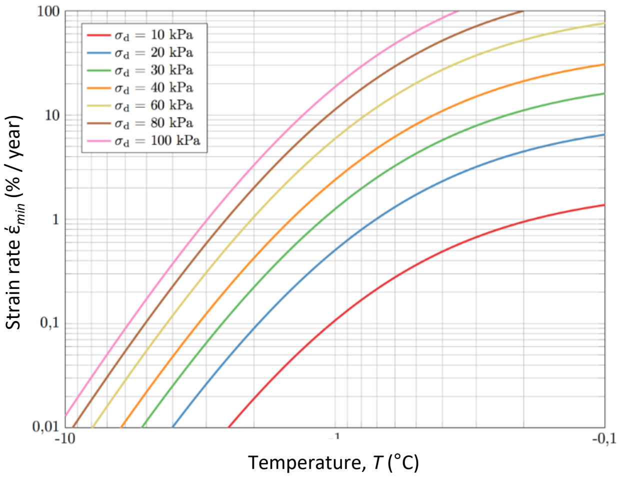
- Static load σ_v = 20 kPa, σ_h = 10 kPa
- Dynamic load $\Delta\sigma_v$ = 18 kPa



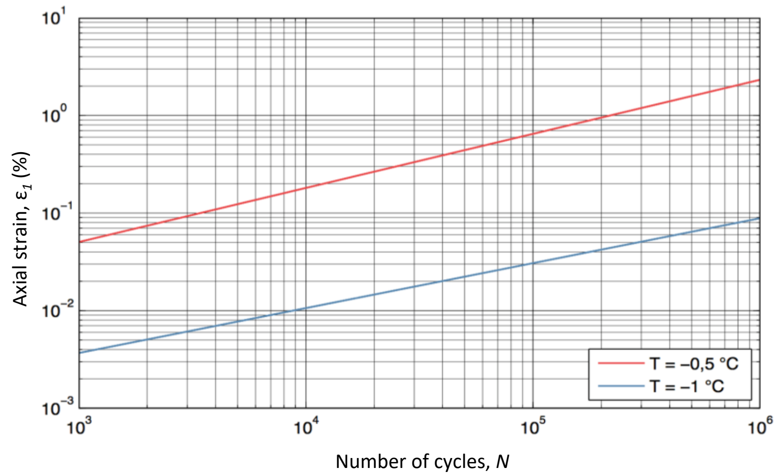
Modified triaxial cell with glycol circulation around the sample



Top and bottom loading platens allow glycol to circulate for better control of temperature



Static creep interpretation
Combination of experimental results
with data from litterature
(warm T/low stress)



Dynamic creep interpretation
(extracted from substracting the extrapolation
of the static creep)
*based on limited laboratory results

RESULTS

The relative contribution of dynamic load is responsible for approximately 70 % of total settlement in the conditions tested.

Total annual settlements are low but do not consider :

- primary creep
- thawing – consolidation in permafrost
- settlement in the embankment
- climate changes

EXAMPLE OF APPLICATION

Embankment built on sensitive permafrost

- thickness = 1 m
- summer = 100 days
- traffic = 50 trucks / day

Static creep settlement = 1.1 mm
Dynamic creep settlement = 2.3 mm

Total settlement is 3 times m ore significant when considering dynamic solicitation

Heavy trucks passage must be considered on thin embankments
to minimize creeping of thaw-sensitive permafrost

BENEFITS

- New methodology to conduct drained triaxial creep tests with precise temperature control.
- Adaptation and recalibration of existing static creep models to quantify static settlement.

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