Development of An Oedometric Core-Barrel For in Situ Measurement of The Thaw Consolidation Behavior of Permafrost

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Theme 2 - M.Sc. project

Objective

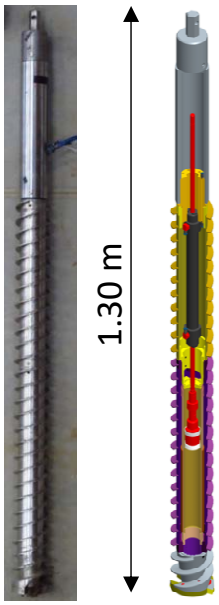
Improve the ability to characterize thaw-sensitive permafrost by developing a core-barrel for in situ thaw-consolidation testing.

Methodology

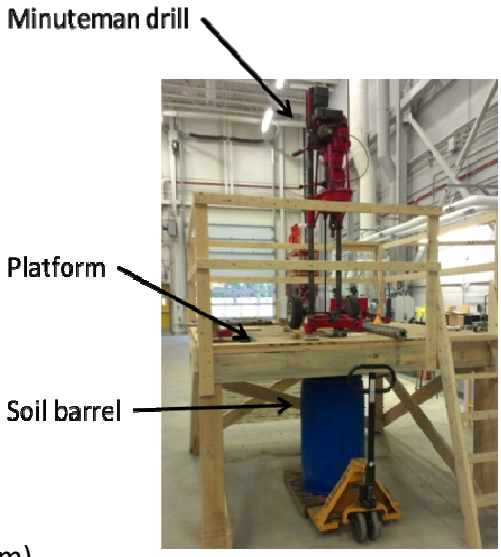
Develop a prototype, considering several specific requirements :

- Specific load and rate of consolidation
- Dry drilling and portable light drill equipment
- Coring in ice-rich soils
- Easy maintenance

Perform laboratory testing on fine (silt) and coarse (sand) soils with reconstituted ice lenses.



Core-barrel (D = 76 mm) prototype and sketch

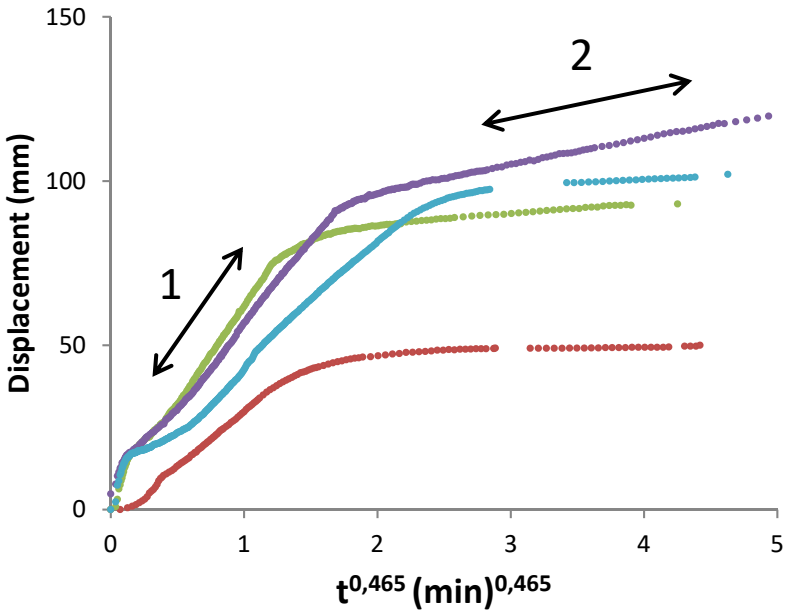


Laboratory test settings

Results

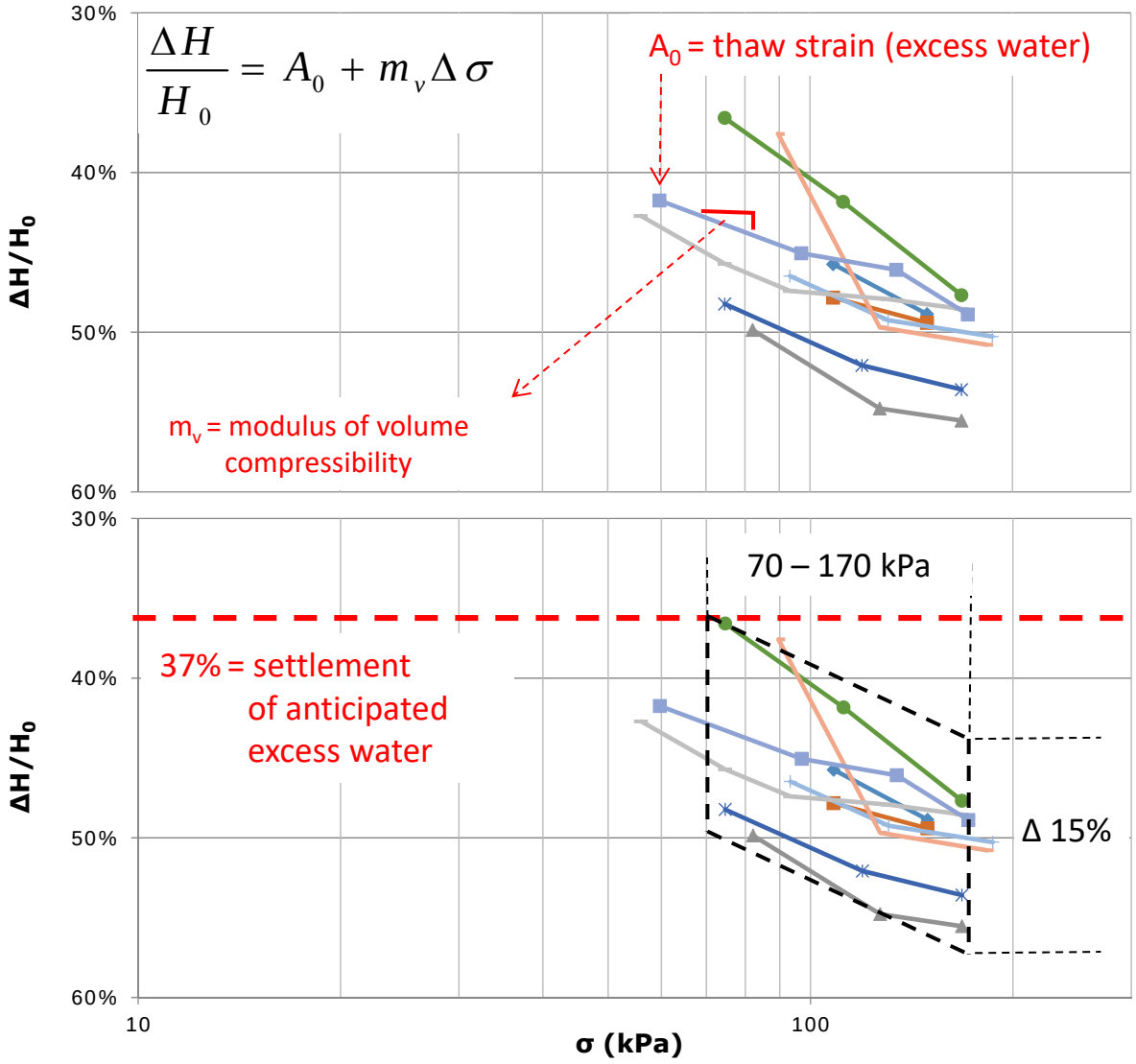
The prototype developed allows to :

- Perform rapid in situ thaw-consolidation tests under a range of vertical loads, instead of bringing frozen samples to a lab
- Estimate thaw-consolidation soil properties such as A_0, m_v and $C_{c\varepsilon}$



Displacement as a function of time (McKinley, 1961)
Phase 1 : Thawing and draining of excess ice (20-40 min.)
Phase 2 : Consolidation (168 kPa load applied after thaw)

Relative displacement curves, a function of the load applied on a sample of sand with ice lenses.



BENEFITS

- Following a presentation of the technology at the 2015 International Conference on Cold Regions Engineering, the oedometric core barrel was qualified as a "major breakthrough in permafrost engineering" by experts in attendance.
- Collaboration between Laval University (Civil and Mechanical Engineering Departments) and Arquluk partners will allow making final adjustments to the prototype and performing field tests.
- The technology is protected by a Canadian patent and the final product will be manufactured and commercialized.