DESIGN PROCEDURE TAKING INTO ACCOUNT ACCUMULATION OF SNOW ALONG EMBANKMENT BUILT ON PERMAFROST

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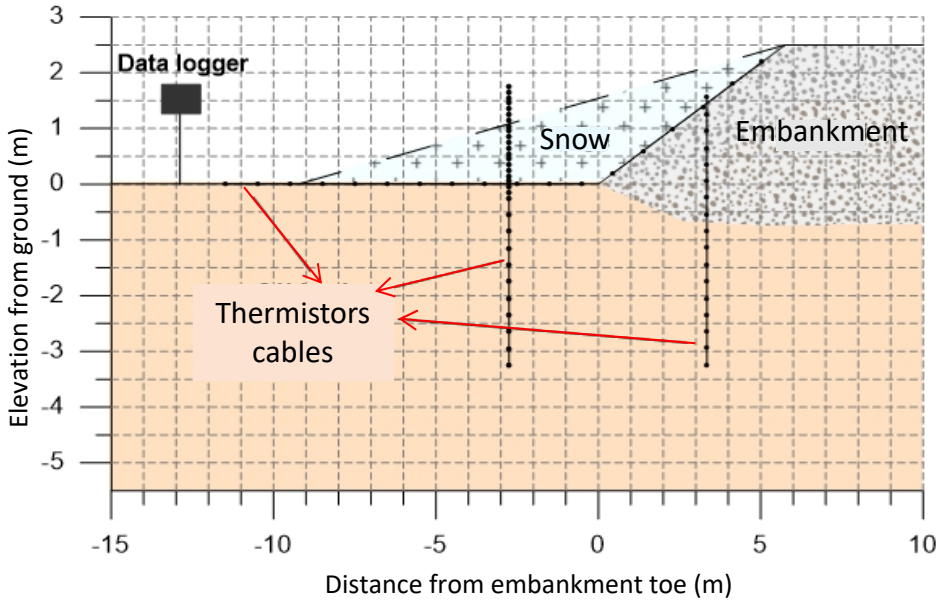
Theme 3 - M.Sc. project

OBJECTIVE

Develop an engineering tool for embankment geometry optimization to minimize negative effects of snow accumulation on embankment slopes.

METHODOLOGY

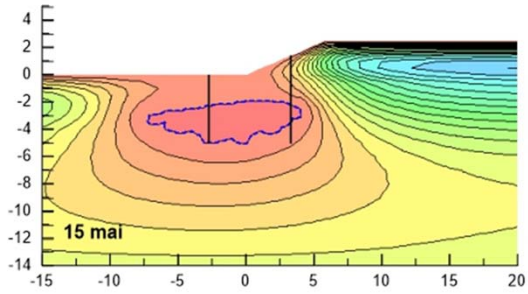
2D geothermal modeling of embankments on natural grounds including the effect of snow accumulation → **Calibrate** the model using field data collected during the winter of 2014-2015 at the Tasiujaq test site → **Quantify the impact** of geometric design parameters



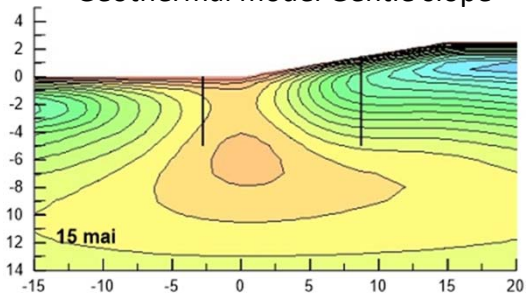
Instrumentation at Tasiujaq airport test site, Nunavik, Quebec.

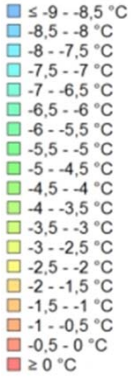
3 thermistor cables monitoring temperature:
- Embankment and natural ground under
- Snow and natural ground
- Interface snow and natural ground + embankment (surface)

Geothermal model calibrated



Geothermal model Gentle slope

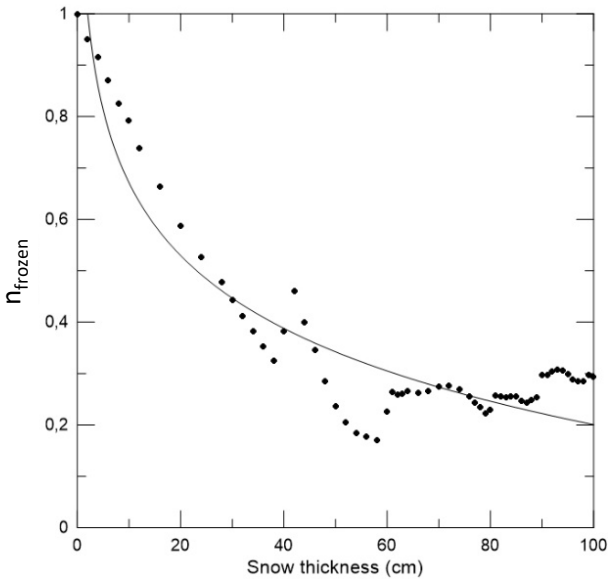




TEMP/W, from GeoSlope

RESULTS

- The relationship between the n-factor and snow thickness can be expressed using a logarithmic function.
- The design procedure method is appropriate for embankments where wind conditions and alignment favour snow accumulation.
- The height of the embankment needs to be considered in the design since gentle slopes are more effective with thick embankments.

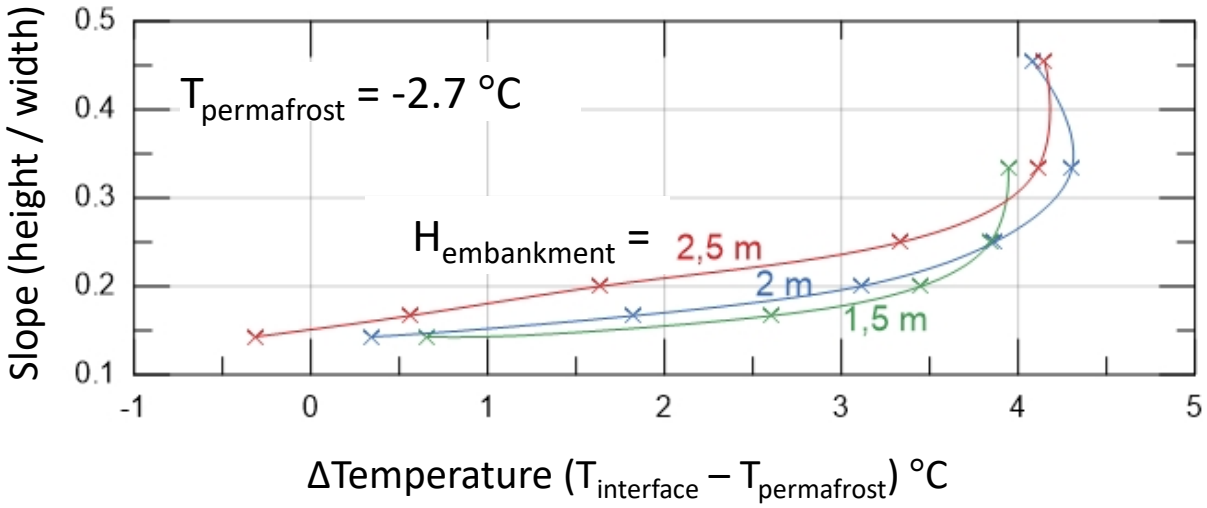


$n_{frozen} = T_{surface}/T_{air}$

Critical snow thickness: 40 cm

Logarithmic relationship: $n_{frozen} = -0.215 \times \ln(h_n) + 1.142$

Design chart (non final) for embankment slope minimizing permafrost degradation due to snow accumulation



BENEFITS

- New design chart enables mitigation of the impact of snow accumulation (insulation) along embankments built on permafrost where wind and alignment are of concern.