

**VEITTOSTENSUO**

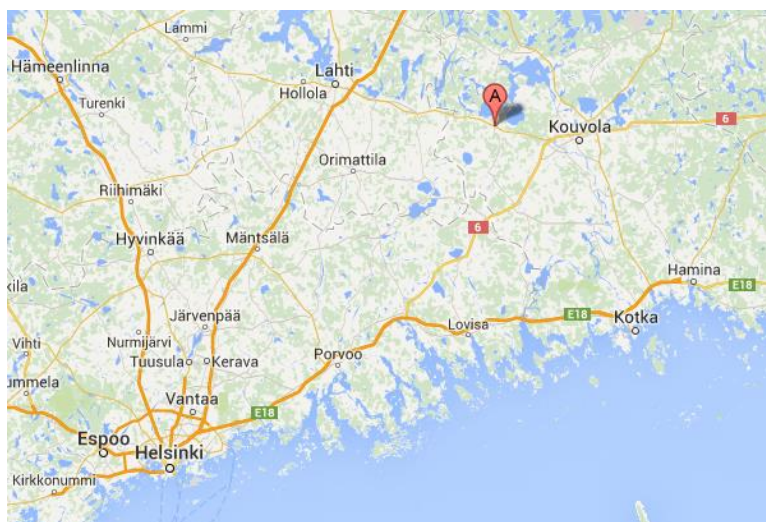
Iitti, Finland

Subgrade reinforcement in a swamp area

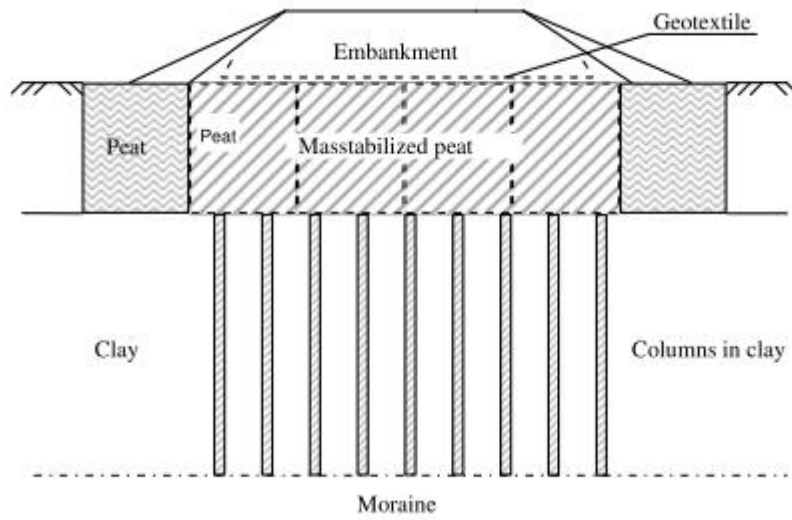
Key words:

road embankment, trial embankment, mass stabilization of a peat layer

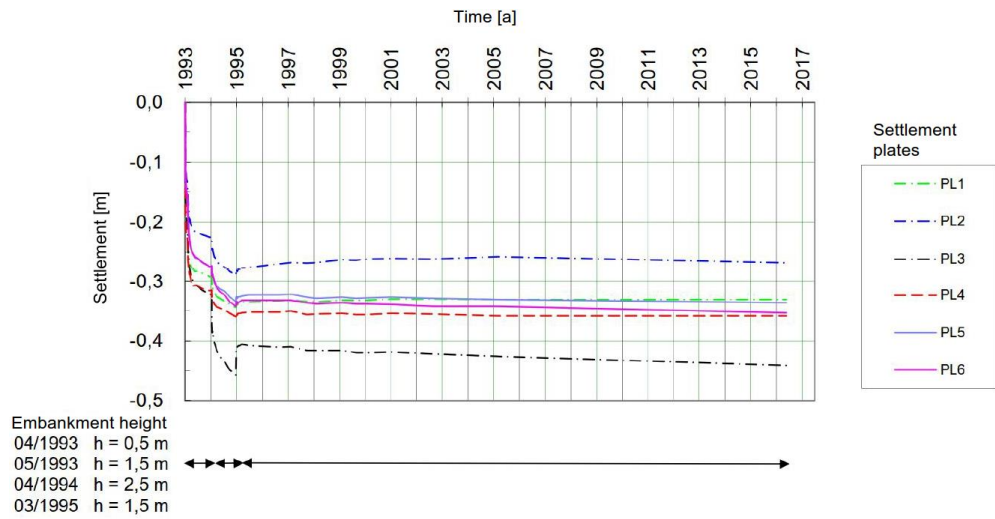
General information	A mass stabilized trial embankment was constructed in Iitti for the needs of a road crossing a swamp area. Construction works were carried out in demanding conditions. The maximum thickness of the soft soil layer was up to 25 m and the thickness of the peat layer was up to 5 m.
Advantages of stabilization	The original solution including piling and mass exchange was expensive. For this reason, a trial structure combining mass and column stabilization was constructed to find a more cost-effective to build the foundation.
Project timetable	1993 column and mass stabilization, 1994 loading with over loading embankment
Volumes and dimensions	The size of the trial area was 13 × 18 m <sup>2</sup> . The total volume of mass stabilization was 500 m <sup>3</sup> , and column stabilization – 2000 column meter.
Geology and stabilized material	The most upper layer was raw peat (up to 2 m). Under this layer, there was a layer of decomposed peat (up to 3 m in the central part of the swamp). The geotechnical properties of the soil layers differed a lot according to changes in depth: peat, about 1-5 m, w=1200-1700 %, clay, about 10-20 m, w=75-125 %, shear strength = 7-20 kPa
Strength of the stabilized material	The target shear strength of mass stabilization was 100 kPa and achieved strength was 90-140 kPa
Binder(s)	Mass stabilization: Finnstabi (gypsum) + rapid cement (125 + 125), blast furnace slag + rapid cement (150 + 150); Column stabilization: Finnstabi (gypsum) + lime (63 + 63)
Laboratory and field tests	Vane test, index tests of the peat and clay layer, oedometer tests in the clay layer, stabilization tests for the peat and clay layers, settlement plates
Other	The Veittostensuo area was the first site in Finland where peat was mass stabilized in natural conditions
Long-term follow-up and lessons learned	One year after stabilization, stabilized peat was strengthened 10-20 times more than it was before stabilization. In the 3 m thick stabilized layer, settlement of 200-300 mm occurred in half a year as a result of the load of 1.5 m of embankment. In 2016 column and vane penetrometer tests were performed, samples taken and settlements measured to examine the long-term strength development. The strength had increased significantly in both mass stabilized areas - especially in the area stabilized with the binder containing Finnstabi. No settlements were observed. The water content in mass stabilized layer had increased significantly and pH decreased by 1 unit.
Sources	Tielaitos 1995. <i>Veittostensuon koerakenteen toiminta ja laadun arviointi</i> . Tielaitoksen selvityksiä 54/1995. Geokeskus Oulun kehitysyksikkö. Piispanen, P., Melander, M., Forsman, J., Winqvist, F. 2016. <i>Veittostensuo, Iitti: Massastabiloinnin pitkäaikaistoimivuus</i> . Research report, Ramboll Finland Oy.
Stabilization contractor	YIT



Cross section of mass and column stabilization.



Settlement plate measurements and embankment heights from 1993 to 2017.



Soundings in 2016 after 23 years from the stabilization.

