

NH1.6

Vegetation as nature-based solution for mitigating hydro-meteorological geohazards on slopes and streambanks

Vegetation as a remedial measure against erosion and shallow landslides in steep soil slopes



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Project -Vegetation as mean for slope stabilisation

- Literature review
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- Report



Erosion and stability problems in Norrland, Sweden



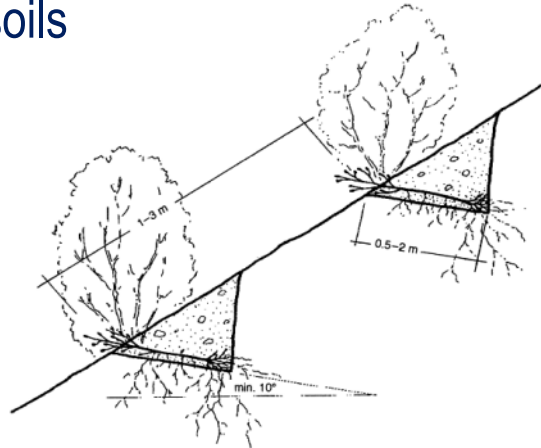
Challenges in general

- Shallow landslides, 1 – 2 m
- Thaw effects
- Porewater pressure and several groundwater pressures
- Water from the road surface

Test site - Bispgården



Problems:
Erosion, frost heaving, thawing,
layered soils



Preventive measures:
Hedge- and brush layers, grass



Plant name, Latin	Plant name, English	Amount of plants (%)
<i>Alnus incana</i>	Grey elder	20
<i>Cornus sanguinea</i>	Dogwood	20
<i>Lonicera xylosteum</i>	Fly honeysuckle	20
<i>Prunus padus</i>	Bird cherry	12
<i>Sorbus aucuparia</i>	Rowan	28

Experiences from Bispgården



First year (2004):

- Bare-rooted plants flourished
- Thick cuttings >5 cm flourished
- Thinner cuttings dried out
- Grass did not successfully sprout



May 2006:

- Solifluction from thawing and rainfall
- Hedge/brush layers slid , some buried
- Test site was terminated
- Slope covered with crushed stones



Test site - Bydalen



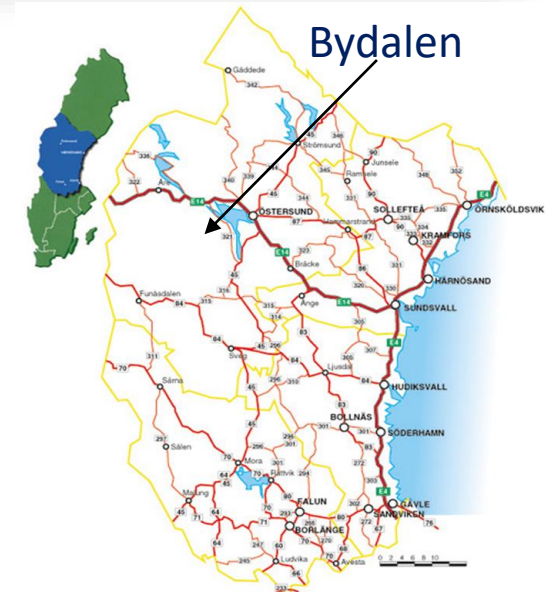
Problems:

- groundwater
- frost heaving
- erosion



Preventive measures:

- Smoothing of slope crests
- Hedge layers
- Coconut mat with plants
- Hydroseeding
- Drainage
- Cutting of deciduous trees



Experiences from Bydalen



- Very marginal signs of solifluction during in thawing or rainy periods
- Deciduous trees which were previously cut sprouted nicely
- Good growth of plants in hedge layers
- Grass grew well, especially when seeded below coconut mat

Road 975 in Näsåker



Road 975



Facts

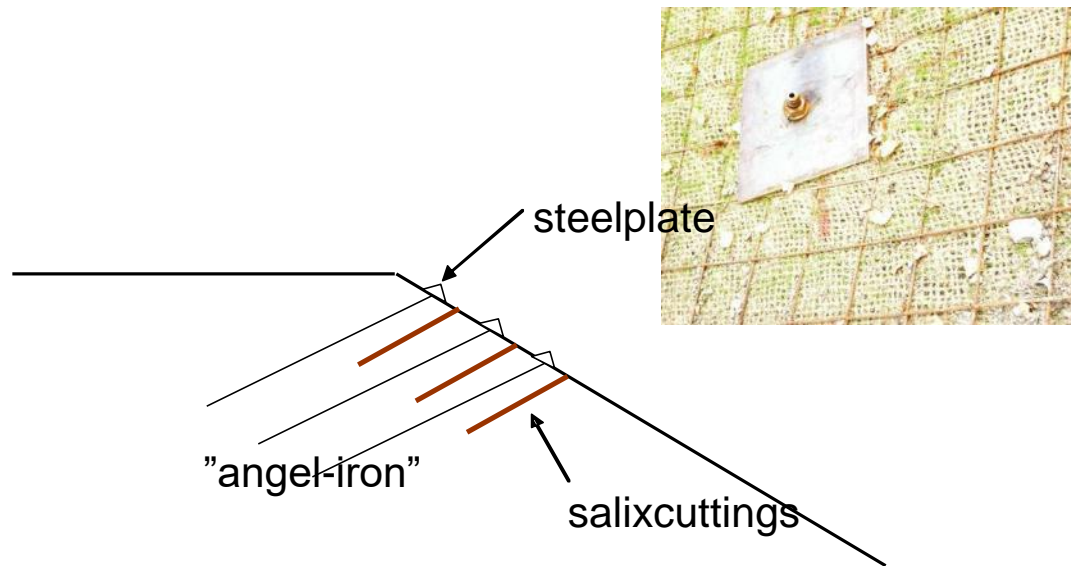
- The road is situated in a steep slope 30-60 m above a river
- The soil consist mainly of silt, with layers of sand and clay
- In this part of Sweden a steep soil-slope is called a "Nipa"
- Existing slope inclination varies between 1:1 – 1:1,5
- Stability without reinforcement, $F_{cf} \approx 1,0 - 1,1$

History

- 1918 Road installed
- 1946 Landslides, repaired with crushed rock
- 1946-1983 Gabion walls are constructed
- 1983 Drainage measures installed
- 1987 Reinforcement with thaw-isolation, displacement of the road and new drainage measures
- 1994 Soil nailing
- 2000 Repair of the soil nailing
- 2001-2002 New soil nailing
- 2005 Landslides, again!
- 2005-2006 Planning of new ideas and measures
- 2006-2008 Reinforcement with vegetation and soil nailing

Reinforcement measures

- Hydraulically pounded angel bars, 6 m, 3 rows
- 2,5–3 m long salix-cuttings, 3 rows
- Nailing and pounding from the road
- Steel net and -plates
- Grass-seeding with coconut mat





Long salix cuttings

Growth of roots on an extracted ~2,5 m salix cutting



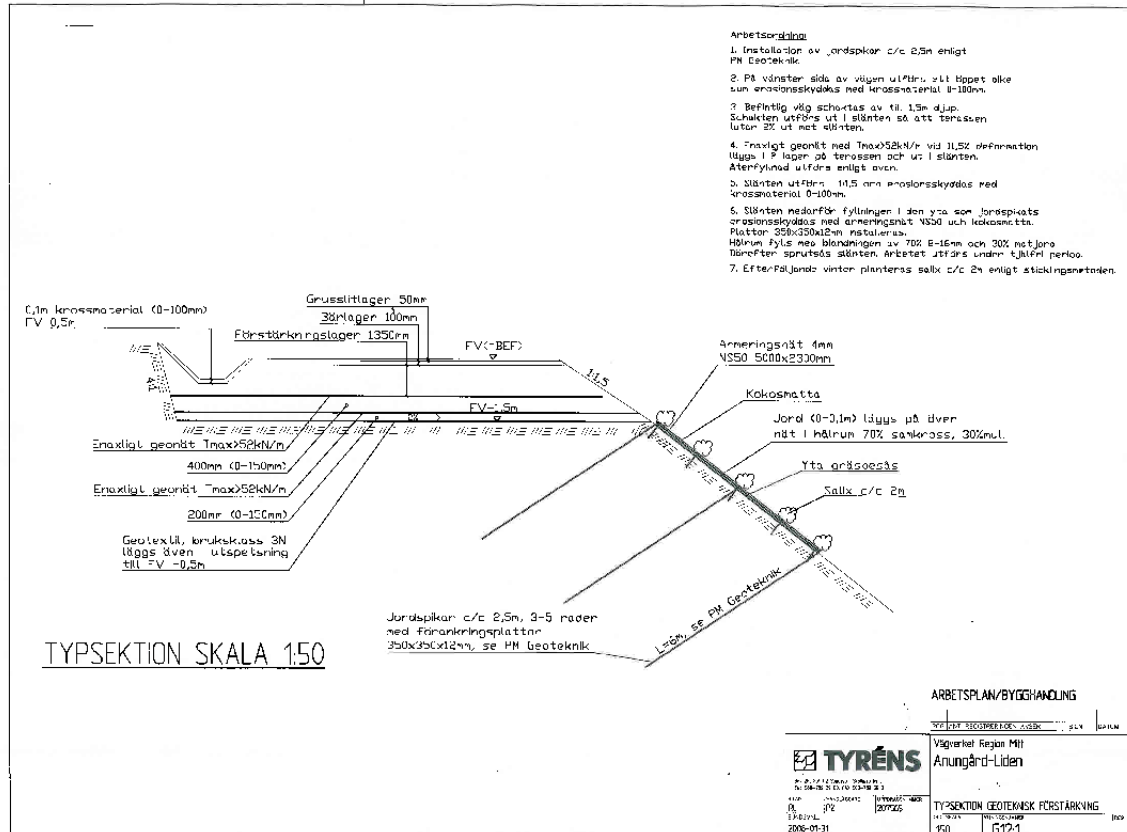
Other measures

- A plan for maintenance of vegetation and soil nails
- Kerbstones and drainage wells
- Monitoring measurements
- Weather stations



The methods are used in other slopes

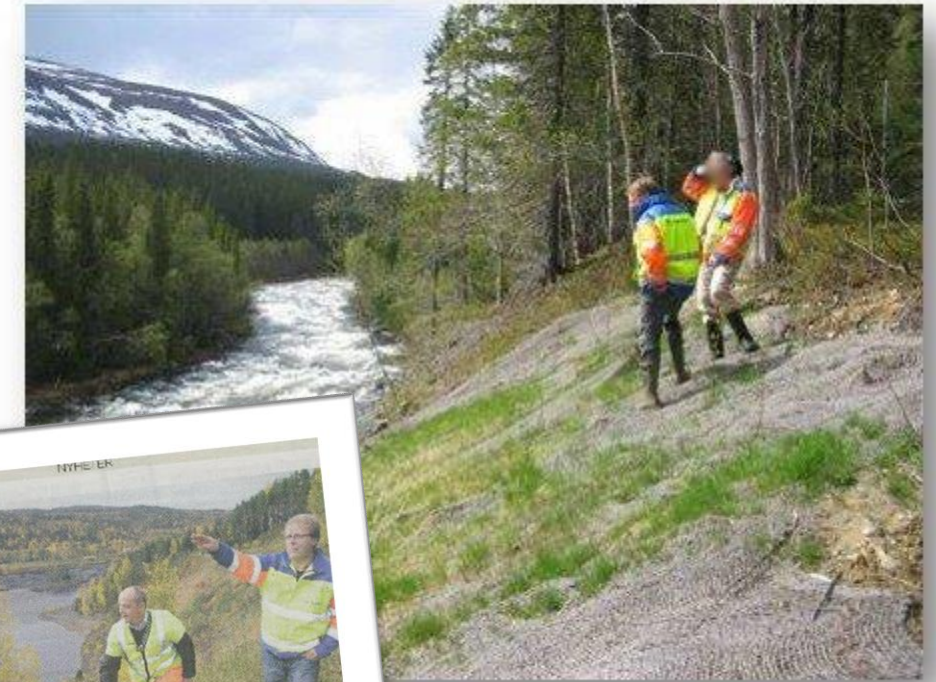
Road 638 Liden





Reports

- Final report from the vegetation project: www.sgi.se.
- TR Geo, TDOK 2013:0668, chapter 9.2.1.1
- Förstärkningsåtgärder, väg 975, Näsåker. Erfarenhetsrapport. Pub.nr: 2017:139



That's all!

