Piled embankment
Membrane calculation for the GR

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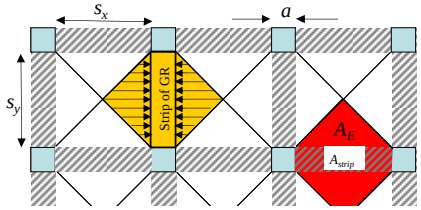
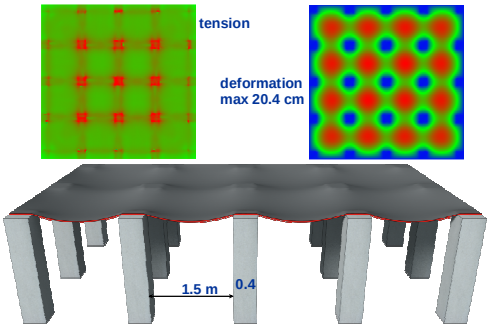
Piled embankment loading on geosynthetic

The membrane action in the geosynthetic reinforcement (GR) in a piled embankment is normally calculated using the catenary equation. This 1-D equation is only used for the strip of GR between the piles (see figure below). All load is transferred to the strip with length *s* and width *a*.



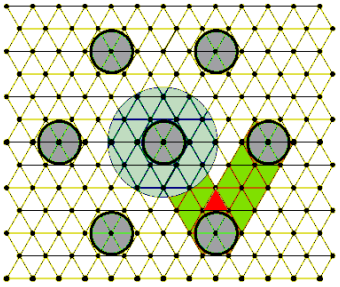
Distribution of loads in a piled embankment, traditional assumption: load concentrated in strips

This may be reasonable for piles in a square grid, see numerical calculation.

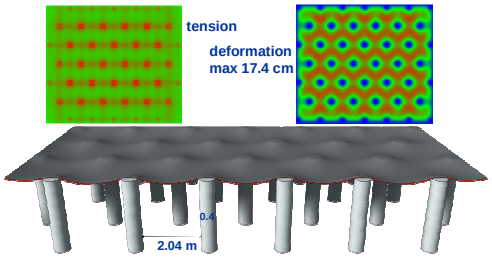


Numerical simulation piles in square grid

For piles and (recently) grids in a triangular grid it is less obvious that this is the right method (see the red triangle in the figure below that is taken twice). The triangular grid of piles and in GR were developed to have a more homogeneous distribution of forces and this is not taken into account when transferring the load to a strip see also numerical calculation.



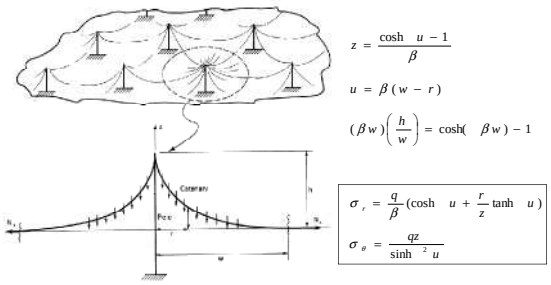
Triangular GR on top of triangular pile grid



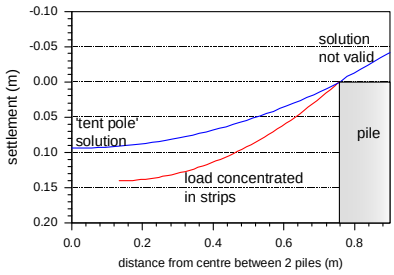
Numerical simulation piles in triangular grid

Analytical 'tent pole' solution:

Symmetrical deformation in a circle around pile, see above (the large circle). Approximate analytical solution by Leonard (1988) for a tent pole. Solution only valid outside the pile. Apart from radial stress also tangential stress and strain are included. For good comparison the area of geosynthetic for each pile must be the same.



Tent pole solution by Leonard



Max. tensile force:
strip: 197 kN/m
tent pole: 173 kN/m

Calculated deflection and max. tensile force from the centre between piles to the pile.
Strip solution square p. grid, membrane solution triang. grid

Conclusions:

- Triangular grids and pile patterns ask for a different calculation method.
- Method from Leonard 1988 can be used.
- Results in somewhat lower tensile force.
- Numerical simulations show similar results.

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