

Design guide for the calculation of stability of slopes with Armater®

Depending on the steepness of the slope and the in-situ fill soil involved, intermediate pins shall be used to ensure stability and avoid overloading of the upper sections of Armater.

A very simple, basic calculation shall be made, which covers most of the usual applications.

It determines the force needed to ensure stability of the fill on the slope in a static situation, taking into account the friction between the in-situ material of the slope and the fill.

A detailed Calculation Note is available on request.



Shear force F along the slope = weight component of the fill parallel to the slope – friction.

Per square metre of slope:

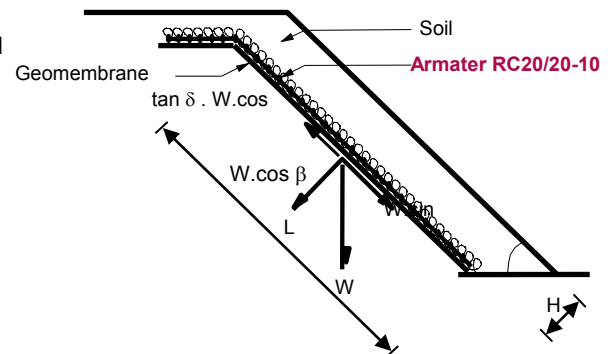
$$F = W \cdot \sin\beta - \tan\delta \cdot W \cos\beta \quad (\text{kN/m})$$

$$W = H \cdot \gamma_s \quad (\text{kN/m})$$

$$\text{Giving: } F = H \cdot \gamma_s (\sin\beta - \tan\delta \cdot \cos\beta) \quad (\text{kN/m})$$

In which:

F	= shear force (per m^2)	(kN/m)
W	= weight of the fill of the Armater (per m^2)	(kN/m)
H	= thickness of the layer of fill	(m)
γ_s	= unit weight of the water saturated fill	(kN/m ³)
β	= angle of slope	(°)
δ	= angle of friction at the interface in-situ surface - fill soil	(°)



Standard Armater has a height of 0.10m and average fill height of $H = 0.12\text{m}$. With an average unit weight of the fill of 20 kN/m^3 this gives: $F = 2.4 (\sin\beta - \tan\delta \cos\beta)$ (kN/m)

A negative value of F indicates that the friction is sufficient to hold the fill material in position, without intermediate pinning. The Armater then reinforces the fill and controls erosion.

Tensile strength P of stitched Armater is a fixed value, provided the materials is installed at 12.5m width, in accordance with the specifications.

The data set forth in this photo leaflet reflects our best knowledge at the time of issue. It is subject to change pursuant to new developments and findings, and a similar reservation applies to the properties of the products described. We do not undertake any liability for results obtained by usage of this information or the products mentioned.



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Based on the short term seam strength of 1.5 kN/0.10 m and short term tensile strength of the nonwoven of 1.75 kN/0.10m, one can calculate the short term (or ultimate) breaking load of stitched Armater.

When Armater is well anchored with a buckle and a sufficiently stiff rebar pin in a sufficiently stable soil, then the short term breaking load $P_{uts} = 1.73$ kN per fixing point.

The allowable design load $P_{all} = 1.15$ kN per fixing point for a height of 0.10m.

The number of intermediate anchoring points N needed to ensure stability is equal to shear force F divided by allowable design load
 $P_{all} : N = F / P_{all} = F / 1.15$ (in anchors/m²)

This means that the use of the buckles makes it possible to fix Armater to the anchoring points without transfer of loads to the anchorage shelf at the top: adequate pinning allows Armater to be used on long, steep slopes!

For an average fill, with an angle of friction with the slope of $\delta = 25^\circ$ and a water saturated unit weight of $\gamma_s = 20$ kN/m³, this results in the following numbers of required intermediate anchoring points:

Slope (V:H)	Angle β	No. of anchors N per m ²	Anchoring density
1 : 3	18.4 °	0	0
1 : 2	26.6 °	0.1	1 anchor/ 10m ²
1 : 1.5	33.7 °	0.5	1 anchor/ 2m ²
1 : 1	45 °	1.0	1 anchor/ 1m ²
3 : 2	56.3 °	1.5	1 anchor/ 0.67m ²



When the calculations indicate that no or limited intermediate pinning is required to ensure stability, we recommend the use of a minimum of 1 anchor per 4 m², to prevent uncontrolled, uneven elongation of Armater during filling.



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