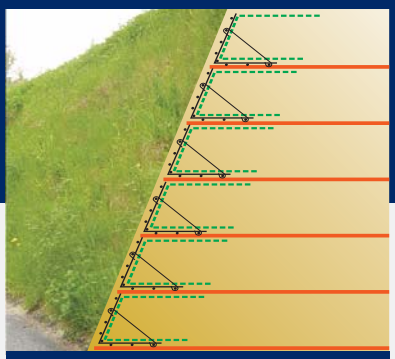
TENCATE Polyfelt

Polyslope S
Installation Guidelines



Polyslope S

1. General

The following is required to construct a geosynthetic-reinforced soil structure using the Polyslope S system:
- Personnel: 2 unskilled workers, 1 machine operator
- Equipment: 1 excavator or loader, 1 vibro-compactor
- Material: Apart from the material necessary for the reinforced-soil structure (see Pt. 2), the following material is required: colour spray, measuring tape (20 m), binding wire, pliers, scissors, knife, shovel, bolt cutter; eventually 2 jacks and a 6 m long steel rod or pipe (diameter approx. 60 - 100 mm), see Pt. 3.3.

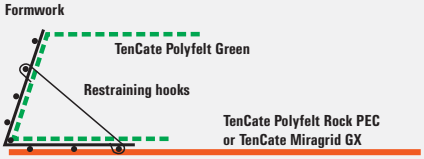
After an initial training phase, production of around 50 m² wall surface area is quite feasible. Each working day should be finished with the completion of one single layer.

2. Materials

Reinforcement:
- TenCate Miragrid GX geogrid for non- or light cohesive soils, or
- TenCate Polyfelt Rock PEC geocomposite for cohesive soils

Formwork:
- Steel mesh, bent to the required angle, as sacrificial formwork, preferably with bent-over ends. If bar ends are not bent over, a slit plastic pipe is required (see Pt. 3.4).
- 4 restraining hooks per formwork element (3 m length), exactly cut to desired geometry of the steel grid, and pre-bent.

Erosion protection:
- TenCate Polyfelt Green erosion-protection grid



Construction materials

3. Construction steps

3.1 Securing and drainage of the existing slope

The existing slope (behind the geosynthetic-reinforced structure) has to be stabilised and secured against erosion and sudden fall.

Special care has to be taken that during rainfalls no local drains will appear on the slope which could subsequently allow the rain water to run over the earth structure during construction. Furthermore, the fill must be protected from being saturated with rain water by an suitable cover, in order to guarantee adequate compaction.

When cohesive fill material is used, an adequate drainage between fill and in-situ slope has to be provided, in order to eliminate the danger of hydraulic pressure (see point 4.). All waters have to be drained off carefully by suitable measures.

3.2 Preparation of the subgrade

The subgrade must be levelled and compacted, and of appropriate bearing capacity. The surface must be even (sloping neither backwards nor forwards), as this is essential to guarantee the designed slope angle.

Subgrade compaction

3.3 Cutting of the geosynthetic

For the unrolling of reinforcement geosynthetics we recommend using a simple rig, consisting of two jacks and a steel rod or pipe approx. 6 m long (as shown in the photo on the right). If a larger area is available, the geosynthetic can be rolled out and cut to size also there.

The reinforcement is then cut to the design anchor length L using a Stanley knife or a pair of scissors. It may be useful to mark the required length on the ground with spray paint. The principal tensile direction should be marked with colour spray on the Miragrid GX to avoid placement errors. Rock PEC is equipped with a red thread running in longitudinal direction, 500 mm from the edge.

Unrolling rig

3.4 Installation of the geosynthetic

The cut panels are placed at right angles to the edge of the slope. Never mix up longitudinal and transvers direction! Folds or wrinkles must be avoided, and a slight tension should be applied.. Adjacent panels shall be overlapped by 200 mm.

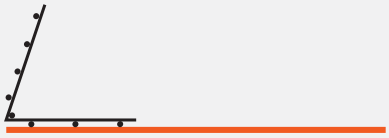
Placement and overlap of reinforcement geosynthetic

3.5 Placement of formwork

The steel-mesh shuttering, bent to the required angle, is placed precisely onto the previously installed geosynthetic panels. Precise horizontal alignment of the formwork elements is essential to guarantee the designed slope angle.

Adjacent formwork elements shall be overlapped so that vertical steel rods can be fixed to each other with binding wire. The fixing shall be done in 3 spots to avoid displacement of the elements during filling and compaction.

Protecting personnel and material:
Wherever possible, steel mesh with bent-over bar ends should be used. If such elements cannot be provided, longitudinal slit plastic pipes or U-shaped profiles can be fixed to the sharp-edged ends of the mesh to eliminate the danger of damage or injuries. This protection is removed after the completion of each layer.



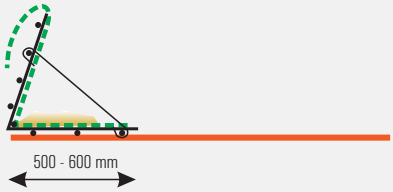
Placement of formwork elements

Protecting personnel and material

Connecting the rods at overlaps

3.6 Installation of the erosion-protection grid

TenCate Polyfelt Green is unrolled parallel to the formwork elements along the entire length of the slope, cut and placed into the inside of the formwork. The panel is placed such that 400 - 500 mm covers the horizontal leg of the formwork element.



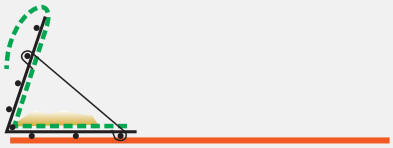
Green is then led up the front face of the formwork and allowed to hang over the edge by a minimum of 600 mm. Special care must be taken that the shape of the formwork element is carefully followed, especially in the sharp angle at the front of the slope.

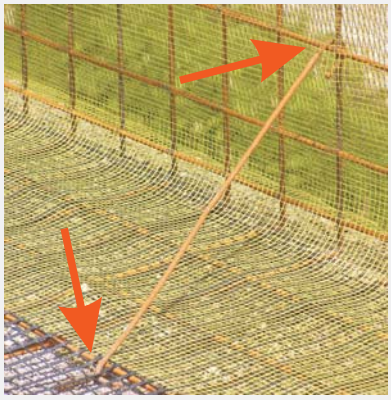
If necessary, Green should be held in place with some soil, especially in the case of strong winds.

Careful placement of the erosion-protection grid

3.7 Restraining of the formwork elements

In order to guarantee the designed slope angle, the formwork elements must be secured with restraining hooks. These hooks are fixed to the transverse rods of the steel mesh, penetrating TenCate Polyfelt Green. The hook is first fixed to the front, sloping leg of the formwork, and then to the horizontal leg by slitghtly pressing the legs together. Hook spacing shall be approx. 0.6 m (4 hooks per 3 m element) or max. 0.8 m..



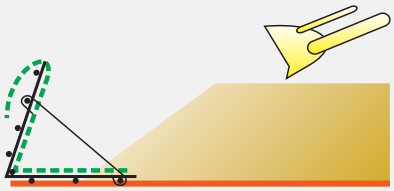


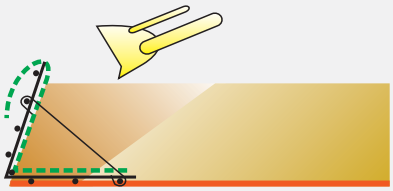
Connecting the restraining hooks

3.8 Installation of the fill material

The locally available soil can be used as fill material, provided 98 % Proctor density can be achieved. This can be critical in the case of cohesive, water-saturated soils.

Immediately behind the steel mesh / TenCate Polyfelt Green, a strip of topsoil, approx. 300 - 500 mm wide, shall be placed. This soil should have a max. grain size of 40 mm and provide adequate nutrients to promote growth of vegetation.





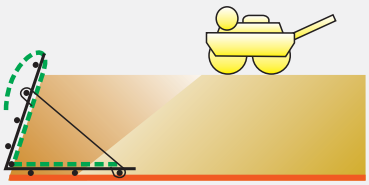
The material shall be carefully placed with an excavator or loader to the required thickness. This layer thickness depends on the design (vertical distance of the reinforcing layers) and on the effectiveness of the compaction equipment used. Not more than 300 mm of fill shall be placed at once.

The surface of the installed soil material shall be levelled in order to achieve an even surface prior to compaction. After compaction 50 mm of the formwork element shall be protrude the surface of the fill (as a guidance, the upper horiziontal rod can be used!).

Fill of topsoil along the edge of the slope

3.9 Compaction

Compaction shall be carried out with static or dynamic equipment, depending on the soil material used. Vibro-rollers or hand-guided vibration plates are suitable machines for this purpose. In any case, a minimum of 98% Proctor density is strongly recommended.



The compaction shall start from the front of the formwork element to the rear of the fill, in order to tauten the reinforcing geosynthetic. Any deformation of both the formwork element and the restraining hooks must be avoided, thus a careful compaction especially along the front face of the slope is essential, using a hand-guided compactor (< 1.5 to).

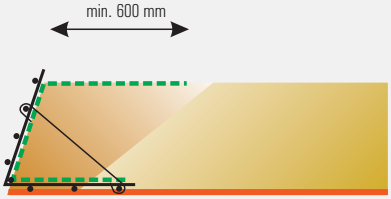
In order to achieve satisfactory compaction right up to the front of the reinforced soil mass, the topsoil placed at the front of the structure should be pre-compacted into the toe of the steel mesh using a shovel or other manual means. This shall prevent the formation of cavities near the front face. Additionally, larger stones (> 400 mm) must be removed at this stage. The use of mechanical plant to compact the topsoil should be avoided as over-densification will inhibit plant growth and excessive compactive effort may deform the mesh face.

Compaction of the rear part of the slope

Compaction of the boundary strip

3.10 Folding back the erosion-protection grid

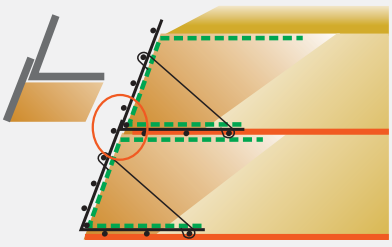
The overhanging part of TenCate Polyfelt Green is then folded back, and the next layer of the reinforcing geosynthetic is placed on top. The very top layer of Green is then covered with a min. 150 mm thick soil layer. This soil cover is also required when berms are constructed, i.e. when the next layer is shifted by a minimum of 200 mm to the rear.



Installation and compaction of the topsoil along the slope surface by hand

3.11 Placement of the formwork for the next layer

For subsequent layers, steps 3.2 to 3.10 have to be repeated accordingly! As the formwork elements of the lower layer protrudes the level of the fill by 50 mm, the new element can be placed directly inside the lower, guaranteeing a smooth surface. The required slope angle must be taken into account. Never place the new elements on top of the lower ones!



Placement of the formwork for the next layer

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4. Drainage

If you expect a build-up of pore water pressure inside the slope, provide for adequate drainage behind or below the retaining structure. In this case, water should be drained from the area by using a pressure-resistant geosynthetic drainage mat (e.g. TenCate Polyfelt DC). The pore water is collected from behind the retaining structure and transported through collecting pipes to be discharged into a receiving water body. This drainage system must be installed up to a level of at least two third of the maximum height of the retaining structure.

Drainage behind the reinforced earth structure

5. Built-in elements

Since reinforced soil is a flexible system that sets free forces by deformation, smaller built-in elements such as pile-driven guide rails or drain pipes do not pose a problem. The local forces are shifted so as to avoid destabilising the total structure. Larger built-in elements that cut through more than one layer of reinforced soil need to be adapted to comply with static requirements.

Buil-in elements

Fall arrest system

6. Fall arrest system for retaining structures > 2 m

For retaining structures exceeding a height of 2 m a fall arrest system needs to be in place throughout the installation works. After completion, this should be replaced by a railing or other barrier system.

7. Vegetation

The surface of the slope can be vegetated either by normal seeds or by means of saplings. Both seeds aplings (e.g. willows) can be integrated during the construction phase. The choice of suitable plants depends on local climatic conditions, and should only be undertaken by those with suitable horticultural experience.

Vegetation applied by hydroseeding

Integrated saplings

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