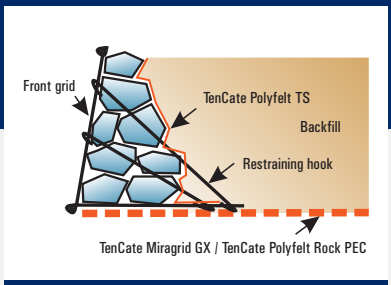
TENCATE Polyfelt

R+F Ecowall®

Installation Guidelines



R+F Ecowall®

1. General

For the construction of a R+F Ecowall geosynthetic-reinforced soil retaining structure, the following is required:

- Human resources: 2 auxiliary workers, 1 machine operator
- Equipment: 1 excavator and/or loader; 1 vibratory compactor
- Material: in addition to the materials needed for soil retention (see item 2) the following small parts are required: can of spray paint, measuring tape (20 m), binding wire, pincers, binder pliers, wrench, scissors and/or wallpaper knife, spade, bolt cutter, optionally 2 wooden stands and a 6-m-long metal tube (diameter approx. 60 - 100 mm), see item 3.3.

After a start-up phase, on-site personnel is expected to complete 36 m² of wall facing per day. Each work day one layer should be completed.

2. Building materials

Reinforcement:

- TenCate Miragrid GX geogrid or
- TenCate Polyfelt Rock PEC geocomposite

Formwork:

- R+F Ecowall® steel mesh elements
- steel bars Ø = 25 mm (total length = length of supporting wall)
- steel hooks Ø = 5 mm, 5 pcs. with length 500 mm and 5 pcs. with length 820 mm for each steel mesh element

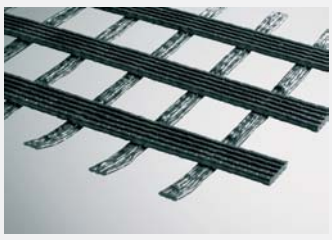
Geotextile:

- TenCate Polyfelt TS

Front stones:

- Frost-resistant stones for the facing system: grain form and size depends on the mesh width of the applied Ecowall and on the visual effect desired

Supply of the front system on pallets



TenCate Miragrid GX - Geogrid

3. Work steps

3.1 Reinforcement and drainage of existing slope

The existing slope (behind the geosynthetic-reinforced retaining structure) has to be stabilised and protected against erosion and falling stones. Special care must be taken to prevent local water runoff across the slope in case of rainfalls, as the water would then flow across the retaining structure under construction!

3.2 Preparation of the foundation base

The foundation base/subgrade needs to be levelled and compacted. Its gradient must not be perpendicular to the front edge of the slope, as this would result in a different slope angle. Sufficient load bearing capacity depending on the height of the slope must be provided.

Compaction of the subgrade

3.3 Cutting the geosynthetic material to size

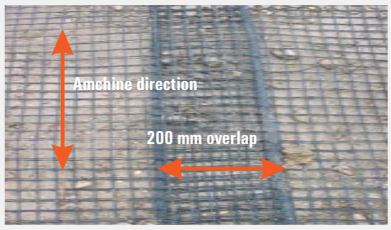
To roll out the TenCate Miragrid GX or TenCate Polyfelt Rock PEC, we recommend using a roll-out frame consisting of two wooden stands and a steel bar of approx. 6 m in length. If a larger flat area is available, the geosynthetic may also be rolled out and cut there.

Miragrid GX or Rock PEC is cut to match reinforcement length L in compliance with static requirements. Use scissors or a wallpaper knife to cut the material to size. It may be useful to mark the length on the ground with spray paint. The length of the reinforcement material (main stability) of the geosynthetic also needs to be marked with spray paint to avoid confusing lengthwise and crosswise directions.

Cutting off the geosynthetic

3.4 Installation of the geosynthetic

Lay out the size-cut grid layers in a lengthwise direction perpendicular to the face of the slope, starting approx. 50 mm behind the front edge. It is absolutely essential not to confuse lengthwise and crosswise directions! Install the layers without folds and wrinkles, keeping the grid under moderate tension. Arrange adjoining layers to overlap by approx. 200 mm.



Installation of the geosynthetic

3.5 Assembly of R+F Ecowall® steel mesh elements

Steel mesh elements are supplied on pallets. Join the elements together on a flat surface and perform the following steps:

a) arrange the supplied elements (soil and front mesh) with the longitudinal bars facing down;

b) join the two elements together by inserting the plug-in lock in the loops of the individual parts;

c) place an additional steel mesh on top of the front mesh to reduce mesh width; this is only of relevance if the available stone aggregate makes it necessary to reduce the standard mesh width;

d) flap the front mesh to the top and fix it at the desired slope angle by using a gauge.

e) The restraining hooks need to be attached as illustrated below. When fixing the hooks make sure they always extend across the longitudinal AND transverse bars of the grid. Use a wrench to bend the attached hooks into place, thus fixing the front mesh gradient. 5 pairs of restraining hooks per element are needed; spread them evenly across the entire width.

Preparation of front and bottom grid

Inserting the plug-in lock

Installation of inner grid (if necessary)

Fixing of the restraining hooks

f) In case an additional formwork grid (variant 2) is installed, the latter is attached to the third longitudinal bar (from the front) of the soil mesh by using a binding wire and fixed parallel to the front mesh. Lay a filtering fleece (TenCate Polyfelt TS10) over the interior mesh. Then attach the restraining hooks as described under e). The interior formwork grid is tied to each of the restraining hooks with a binding wire.

Overlapping and fixin of adjoining elements

3.6 Installation of formwork elements

a) The formwork elements arranged in accordance with the slope gradient are placed on the already installed geosynthetic layers level with the planned slope face. Caution must be exercised to position the formwork elements horizontally, to avoid altering the planned slope gradient.

b) Adjoining steel mesh elements are positioned to slightly overlap and are tied together with a binding wire (3 times for each join) to avoid accidental displacement during the filling and compaction process.

c) Temporary steel tubes (Ø = 30 mm) are attached on a level with the upper longitudinal bar; they provide a rigid frame during the fill-in process. Sections are fixed to the elements with a binding wire at each restraining hook and can be removed when the compaction of the fill material is completed.

Temporary stiffening (e.g. steel pipe)

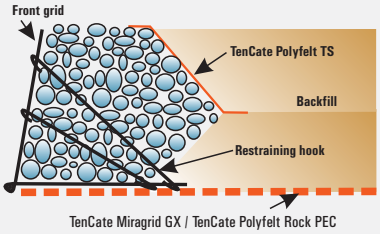
d) The aligned and stabilised steel mesh elements are firmly anchored to the subgrade with three pegs each to avoid displacement.

3.7 Placement of fill material and stone aggregate

Fill in frost-resistant material down to frost penetration depth. The adjoining soil may be used as backfill, provided that a compaction of > 98% proctor density can be achieved.

Variant 1: Stone aggregate (rounded stones)

a) Placement of fill material
The first 30 cm layer of fill material is applied and compacted.
Caution must be exercised to ensure that the fill material reaches no further than to the restraining hooks. Level the fill material after placement to assure a smooth surface during subsequent compaction. Choose the appropriate amount of fill material to ensure approx. 5 cm clearance between the R+F Ecowall® steel mesh element and the fill material after compaction. Use the top transverse bar of the element for orientation.



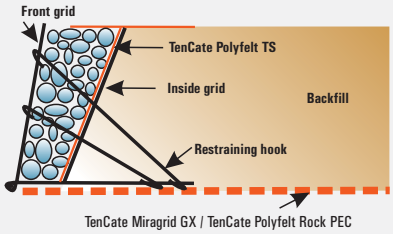
Variant 1: Stone aggregate

b) Placement of stone aggregate
The stone aggregate is filled in across the entire height of the formwork elements. Care must be taken when filling in the stones to prevent damaging of the restraining hooks and front mesh. It is also important to avoid the formation of cavities inside the fill material.

c) Installation of separation fleece
A one-metre-wide TenCate Polyfelt TS fleece strip is placed over the stone aggregate to ensure adequate separation.

d) Placement of second layer of fill material (backfill)
The second layer of fill material has to be applied up to a height as predefined by the formwork element and compacted. A proctor density of > 98% is recommended. Attention must be paid to prevent deformation of the front mesh during compaction.

e) Height adjustment
When applying stone aggregate and backfill in the area of the foundation of the steel mesh elements, ensure that the latter protrude at least 4 cm and at most 9 cm from the top longitudinal bar of the front mesh. If necessary, add gravel to smoothen the surface of the stone aggregate.



Variant 2: Stone aggregate with inside grid

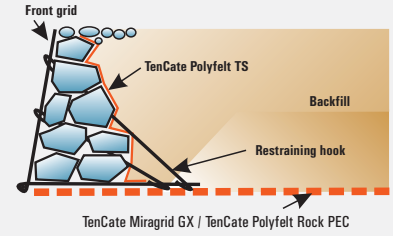
Variant 2: Stone aggregate (rounded stones) with inside formwork grid

The stone aggregate is basically applied in the same manner as in variant 1, except that the stone aggregate is filled in between front mesh and formwork grid.

Variant 3: Stone aggregate (broken stones)

a) Placement of fill material
The stone aggregate is basically applied in the same manner as in variant 1.

b) Placement of stone aggregate
After applying the first layer of fill material, place the front stones directly behind the formwork grid by hand. The stone aggregate finishes 4 9 cm above the upper edge of the steel mesh (top transverse bar). The required installation width results from the short-term stability of the stone aggregate.



Variant 3: Broken stone riprap

c) Installation of separation fleece
Place a TenCate Polyfelt TS fleece strip behind the stone aggregate; this serves to permanently separate the stone aggregate from the fill material. Place a cut in the area of the restraining hooks to ensure that the fleece tightly adheres to the stone aggregate.

d) Placement of second layer of fill material
Insert frost-resistant material behind the stone aggregate down to frost penetration depth, then add backfill and assure proper compaction (proctor density > 98%). Caution must be exercised to prevent that stone aggregate is pushed outside.

e) Preparation of foundation/subgrade for the next layer
After completion of the layer, add a thin layer of gravel to adequately smoothen the surface of the stone aggregate to accommodate the upper formwork. The stabilising section of the formwork element can now be removed.

3.8 Placement of formwork for the next layer

To produce the next layer, repeat steps 3.2 to 3.7. As the formwork elements protrude 5 cm beyond the aggregate, place the upper meshes in front of the lower ones and insert them until they tightly adhere to form a smooth surface. Then fix the formwork element to the bottom element with a binding wire (three pieces per element). Be sure not to change the planned slope gradient.

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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.

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.

6. Installation of a 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.

TENCATE GEOSYNTHETICS AUSTRIA GMBH
Schachermayerstr. 18 Tel. +43 732 6983 0, Fax +43 732 6983 5353
A-4021 Linz, Austria service.at@tencate.com, www.tencate.com/geosynthetics

BeNeLux	Tel. +31 546 544 811	service.nl@tencate.com	**Poland**	Tel. +48 12 268 8375	service.pl@tencate.com
Central Eastern Europe	Tel. +43 732 6983 0	service.at@tencate.com	**Romania**	Tel. +40 21 322 06 08	service.ro@tencate.com
Czech Republic	Tel. +420 2 2425 1843	service.cz@tencate.com	**Russia / CIS**	Tel. +7 495 739 12 60	service.ru@tencate.com
France / Africa	Tel. +33 1 34 23 53 63	service.fr@tencate.com	**Scandinavia / Baltics**	Tel. +45 4485 7474	service.dk@tencate.com
Germany	Tel. +49 6074 3751 50	service.de@tencate.com	**Spain / Portugal**	Tel. +34 91 650 6461	service.es@tencate.com
Italy	Tel. +39 0362 34 58 11	service.it@tencate.com	**Switzerland**	Tel. +41 44 318 6590	service.ch@tencate.com
Near Middle East	Tel. +971 5048 10557	service.nme@tencate.com	**UK / Ireland**	Tel. +44 1952 588 066	service.uk@tencate.com

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