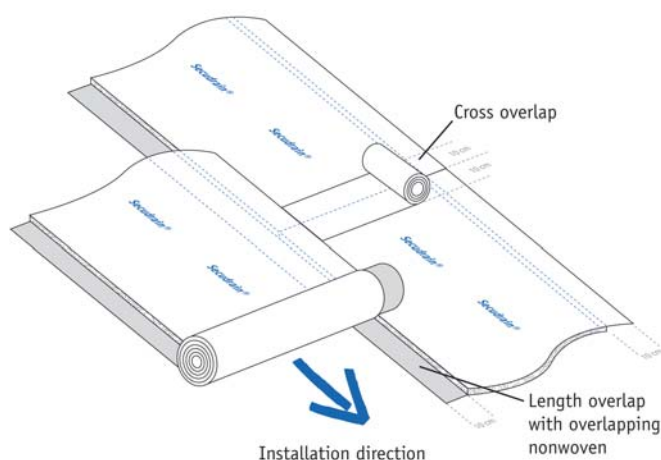


Secudrain® WD

The NAUE Geosynthetic Drainage System Installation Recommendations

NAUE GmbH & Co. KG

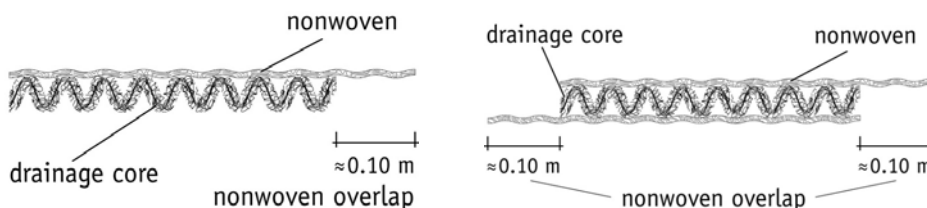


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The following installation recommendation contains general installation guidelines. It is presented as a general format, not as a direct substitute for a project specific drainage specification. In the event of a conflict, the requirement of the project specification will supersede these recommendations. This recommendation does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this guideline to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. The information contained herein has been compiled by NAUE GmbH & Co. KG, Germany, and is, to the best of our knowledge, true and accurate. There is no implied or expressed warranty. Final determination of suitability for use contemplated is the sole responsibility of the user. This information is subject to change without notice.

1. PRODUCT DESCRIPTION

The Secudrain® WD geosynthetic drainage system is a three-dimensionally extruded polypropylene (PP) drainage product manufactured of a wave structured monofilament 3D mesh. Combined with needle-punched nonwovens on one side (e.g. 201 C WD 601) or both sides (e.g. 201 C WD 601 201 C or 131 C WD 401 131 C) they are highly efficient drainage systems. The components are thermally bonded together.



Secudrain® is used in many applications as a drainage collector for precipitation or groundwater but also as a collector for gas (e.g. landfill gas).

Each Secudrain® roll has a label which contains the following information:

- manufacturer's name
- unique roll number
- product identification
- roll length
- roll width
- CE marking

2. SHIPMENT

Secudrain® is delivered to the jobsite with a protective wrapping. Typical Secudrain® roll dimensions are 1.90 m or 3.80 m (length) x 35 m (width). Secudrain® has a permanent roll imprint with the name Secudrain® and the type (e.g. 201 C W D601 201 C). Secudrain® is loaded at the manufacturing facility in such a way that damage during shipment does not occur. Rolls are usually transported with a maximum of 5 layers stacked over each other.



3. STORAGE AND HANDLING

Upon delivery, Secudrain® rolls can be unloaded and transported with standard construction equipment utilising a suitable spreader bar, or by means of suitable loading straps. Alternatively, the rolls can be easily unloaded manually. Damages during this process must be avoided. Secudrain® transportation and handling on site should be done in a similar matter.

Secudrain® should be stored on a flat surface provided by the contractor. The flat surface should protect the drainage mat from damage, abrasions, excessive dirt and moisture. The surface shall be smooth and levelled and protected from theft and vandalism.

If Secudrain® rolls are stacked on top of each other the maximum height may not exceed 5 rolls. They must also be secured against movement.

Secudrain® is wrapped with a protective plastic sheet. Damage should be immediately repaired with tape. If stored outdoors for several weeks an additional protective cover is recommended.

4. VERIFICATION

Secudrain® rolls should be inspected on site in order to identify any damage to the rolls. Any damage should be noted and reported.

Before storing or unrolling, or both, the individual roll identification should be verified and should be compared to the packing list. Any irregularities should be noted and reported.

5. SECUDRAIN® INSTALLATION

Prior to installation of Secudrain® the subgrade or the underlaying material (e.g. geosynthetic) must be approved by the responsible site engineer. The Secudrain® placement methods and equipment should be evaluated appropriately.

Secudrain® rolls should always be installed in the direction of flow unless otherwise specified.

The installer shall take any necessary precautions during the placement of Secudrain® rolls to prevent any damage to the underlying subgrade or layer.

Under no circumstances can construction traffic drive directly over Secudrain®. If a soil is being placed immediately over Secudrain®, site equipment and the installation process must not damage the drainage mat.

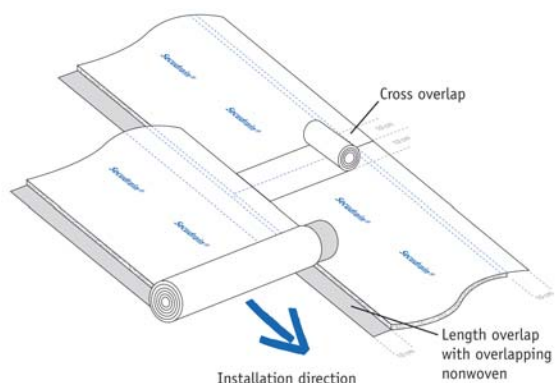
If slopes are steeper than 1(vertical): 5(horizontal) full-length rolls should be used on the total slope length. Alternatively berms may be used to allow an installation. Details can be requested from the site engineer or NAUE, Germany.

In any case it is required that the responsible designer approves the slope stability analysis of the system.

If anchor trenches are specified at the top of the slopes (recommended when slopes steeper than 1(H):5(V)), Secudrain® shall be properly anchored to resist sliding.

Compactors or other compacting equipment shall not be permitted to come in direct contact with Secudrain® or damage the drainage mat during compacting the anchor trench fill. Further details are described in the following sections.

Sandbags should be placed on installed Secudrain® to avoid wind lift or an equivalent measure should be taken. The exact placement pattern is project dependant and is in general specified or should be requested from the responsible specifying or site engineer. The sandbags are usually removed prior to the placement of the next layer.



6. OVERLAPS AND JOINTS

6.1. GENERAL

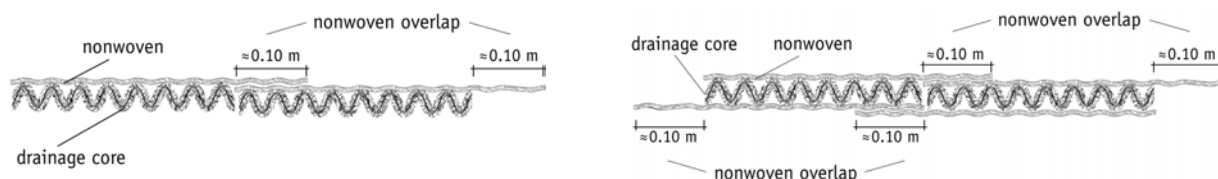
Adjacent Secudrain® rolls shall be installed in such a way that a constant flow between the rolls is ensured. In general adjacent cross overlaps are not permitted. However T-overlaps are allowed. In any case overlaps and joints must be free from debris or any other foreign matter which might disturb the drainage through the drainage core.

6.2. LENGTH OVERLAPS

Secudrain® rolls are manufactured with nonwoven overlaps. The thermally attached nonwoven geotextiles are manufactured in such a way that they extend beyond the drainage core by approx. 0.10 m at the edge (see figures in Section 1). Adjacent roll length edges of Secudrain® shall be placed in such a way that the edges are butted against each other. The overlapping nonwoven geotextile shall then overlap the adjacent drainage core and geotextile filter attached hereto (see figure). If the top side overlapping nonwoven geotextile is on the right hand side of the direction of unrolling it is recommended to then unroll the following rolls to the left.

To avoid cover soil falling or being pushed into the overlap area the following measures are recommended:

- thermally fixing the overlapping nonwoven geotextiles with an hot air welding tool (at approx. 200 °C) at least every 0.5 m
- placement of soil material over the overlapping nonwoven geotextiles.

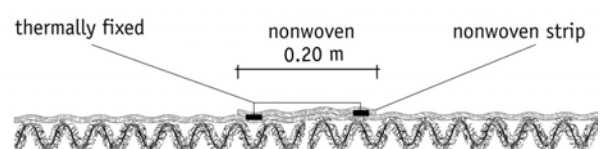
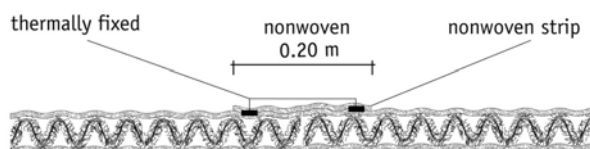


6.3. CROSS OVERLAPS

Cross overlaps of Secudrain® should be butt jointed with each other. It should be ensured that a constant flow is achieved. To prevent movement and soil falling into the jointed area an approx. 0.20 m wide nonwoven geotextile (e.g. Secutex®) should be placed over the butt jointed area.

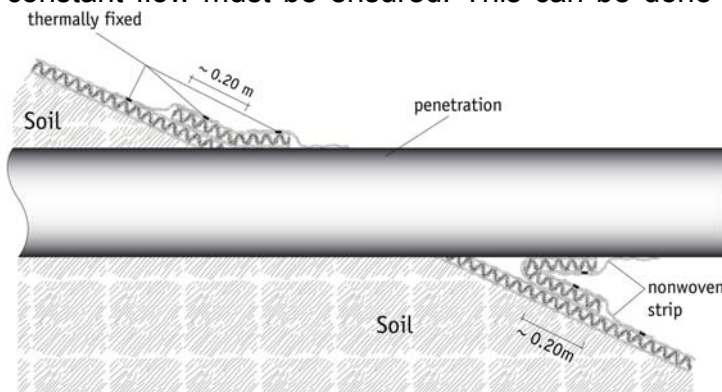
To avoid cover soil falling or being pushed into the overlap area the following measures are recommended:

- thermally fixing of the nonwoven geotextiles with a hot air welding tool (at approx. 200 °C) at least every 0.50 m
- placement of soil material over the overlapping nonwoven geotextiles.



7. PENETRATIONS AND CONNECTIONS

If Secudrain® rolls are installed against structures or if structures penetrate the drainage mat a constant flow must be ensured. This can be done by placing Secudrain® directly against the structure or by using an extra layer of Secudrain® and overlapping a patch in the area of the connection or penetration. In some cases an apron may be suitable. The overlapping Secudrain® can be fixed to the adjacent roll to avoid separation during cover soil or material placement. Overlaps should be carried out according to section 6.

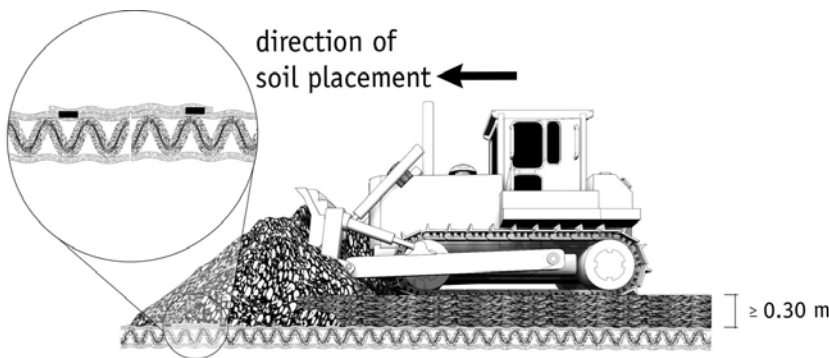


8. COVER SOIL OR MATERIAL PLACEMENT

The placement and spreading of the specified and approved cover soil shall be carried out without equipment driving directly on Secudrain®. In general soil material with a maximum grain size of 63 mm is suitable. In any other case contact the responsible site engineer or the NAUE representative. It is recommended to use vehicles with a low ground pressure. The placement and spreading of the cover shall not damage Secudrain®.

In general a 0.30 m cover soil thickness is adequate for a one way passage without any major equipment turning on the cover soil or without any instant breaking of the equipment.

For frequent traffic a minimum thickness of 0.50 m is recommended. However this value should be verified prior to frequent traffic.

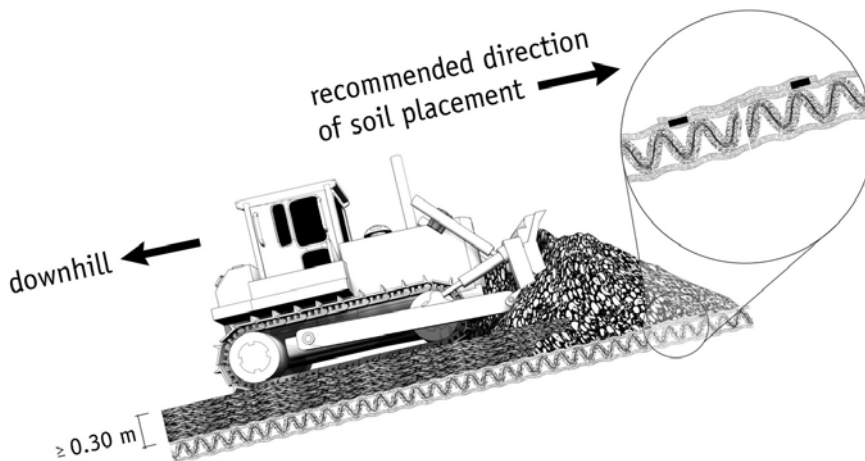


The protection efficiency of Secudrain® over a sealing system must be proven prior to the soil placement.

Cover soil shall be placed from the bottom to the top of the slope upward. If this is not possible it is necessary to contact the responsible site

engineer. In flat areas the cover soil placement can usually be carried out in any direction.

The cover soil shall be installed over Secudrain® in such a way that wrinkles or movements in Secudrain® do occur, soil material does not enter overlapped areas. And the overlaps are not separated.



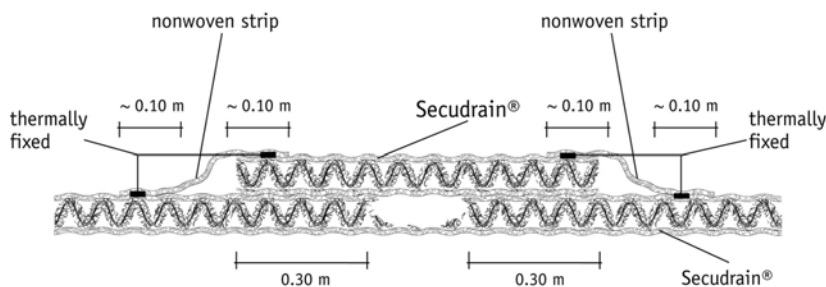
In the case of placement of other geosynthetic materials over Secudrain® the covering procedure of this overlaying material, the specified procedure, or the recommendations from the responsible engineer will supersede this procedure. In any case the procedure may not cause any damage to Secudrain®.

9. INSTALLATION INTERRUPTION

Secudrain® should be covered in Middle European conditions within 4 weeks. However, protection measures against wind uplift are recommended for this period.

For longer uncovered periods special UV-stabilized Secudrain® products are required. In other cases Secudrain® should:

- be covered with cover soil or geosynthetics, or
- should be covered with a plastic sheet or tarp which protects Secudrain® from UV radiation (measures against wind uplift are recommended).



10. REPAIR OF DAMAGED SECUDRAIN®

Prior to any covering process of installed Secudrain®, each installed roll shall be inspected for damage resulting from construction. Any damaged areas (i.e. rips, tears, etc) on installed Secudrain® must be repaired.

This can be done by patching or replacing the damaged area. The patching shall overlap the damaged area by minimum 0.30 m and be fixed as described in Section 6. If the width of the damaged area to be repaired is larger than 1.50 m, the damaged area shall be cut out in the whole width and a new Secudrain® roll shall be attached as described in the previous described sections. In steep slopes it is requested to contact the responsible site engineer whether this method is appropriate.



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