

LandShape® – Retaining walls built during the construction of the major road RW 36 between the RW 835 and Vriezenveen

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ABSTRACT: a project in which two walls were built to avoid two electricity pylons. The reinforcement was in the form of HDPE-geogrids and the wall facing was pre-fabricated concrete panels.

On the route of this new road several engineering constructions are being built. Close to one of the new flyovers there are electricity pylons on both sides. Because of the limited room between these pylons it was necessary to build vertical retaining walls instead of natural slopes. The specification stipulated that reinforced soil with made from ridge steel strips coupled to cross shaped concrete elements should be used.

The construction partnership Reef Wegenbouw en Reef Bouw that had taken on this work which had been proposed to the Rijkswaterstaat (the government department responsible for the maintenance of roads) that these two retaining walls be constructed using the LandShape® System. This is a way of reinforcing soil that uses Tensar geogrids with prefabricated concrete facing panels. LandShape® is marketed by a joint venture between Betonson and Civiele Techniek Nederland. An important advantage with this system of soil reinforcement is that the grids are made from HDPE (High Density Polyethylene) which is considered in civil and military engineering circles as one of the most resistant synthetic materials. This meant that, in contrast to the solution stipulated in the

specification, there were no chemical restrictions on the fill material (sand) nor would the construction need to be covered to prevent the penetration of chemicals such as brine.

The Tensar geogrids that were used are produced by punching holes in a continuous sheet of engineering grade, high density polyethylene which is subsequently stretched in a single direction. This stretching aligns the long-chain molecules in the direction of stretching. As a result high tensile strength and stiffness are achieved at low strains. In collaboration with various universities and research establishments, the manufacturer of the geogrids has carried out, substantial research into the use of this sort of grids in reinforced soil constructions. This research has been directed in the main to the durability and creep characteristics of the material. As a result of this research this material has been approved for use in reinforced soil constructions by many different organizations. The material is approved by amongst others the British Board of Agrément for Roads and Bridges (BBA) and in 1990 also by the Institut für Bautechnik in Berlin. For the design of the walls in

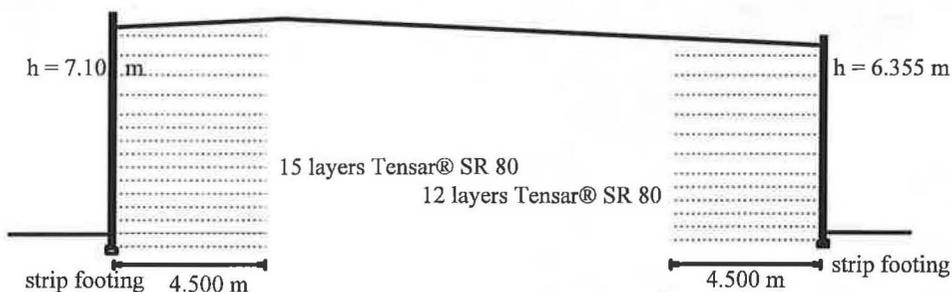


Figure 1. Cross section of the LandShape® reinforced soil retaining walls

the RW 36 use was made of the latest so-called Zulassungsbescheid (nr Z-20.1-102), that has been confirmed with a 'professional opinion' by Grondmechanica Delft.

The calculations for the wall can be globally seen as the calculation of the external and internal stability. The length of reinforcement is determined primarily by the external stability. For this the reinforced part of the wall is considered to be a monolith. In the German approval, as well as in the CUR publication 175 "Geokunststoffen in de wegenbouw en als grondwapening" (Geosynthetic material in road building and soil reinforcement), four critical failure factors are calculated:

- resistance to slip
- resistance to tilting
- resistance to a ground fault
- resistance to deeper slip surfaces.

Using the reinforcement length determined above together with the required internal stability, the quality of reinforcement and the distance between the centers of the layers can be calculated. What is important here is that the active loads and reinforcement loads are in balance. The necessary tensile strength required of the reinforcement is calculated by varying the angle α . When doing this the reinforcement should neither

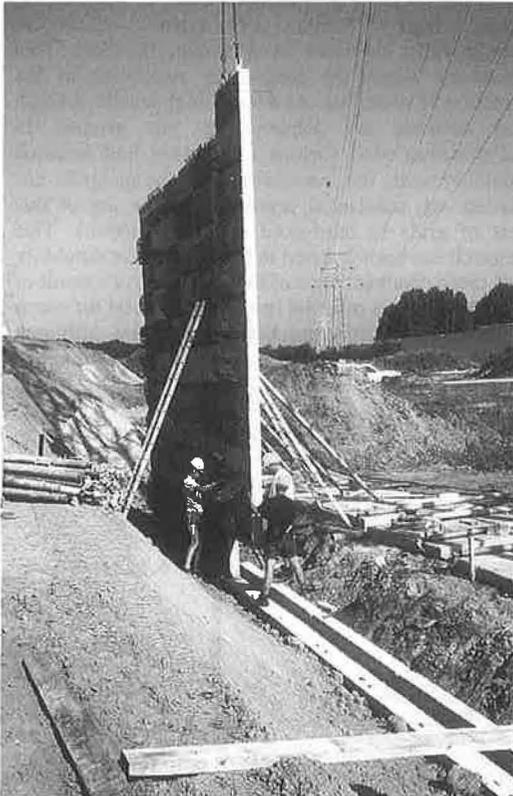


Photo 1.

break nor should the anchor length of the reinforcement be so short that it can be pulled out of the structure.

The LandShape® System's prefabricated concrete panels are manufactured by Betonson. For the facing the client can choose from a whole range of aesthetically pleasing colours and textures. For the RW36 project 25 6.35m high panels and 29 7.10m panels were manufactured. All of the panels were 1.18m wide and 150mm thick. The panels carry a recurring regular pattern that gives the appearance of horizontal pointing. In order to handle the panels on the site they were pre-stressed using 6 16mm diameter centric pre-stressed braids. Prior to casting these braids are led through the oval openings in a short piece of Tensar geogrid. After the concrete (quality B65) has been cast and it has hardened these so-called starter grids extend from the concrete panel at the correct height.

On the construction site LandShape® was shown to be quick and simple to use. The LandShape® panels were placed on a concrete footing which the contractor had cast. The footing was 400mm from front to back, and 250mm deep and with a forward upstand of 100mm x 100mm. The LandShape® panels were temporarily braced to concrete slabs in front of the wall. Wedges were forced between the upstand on the concrete footing and the toe of the panels to hold them in position. The starter grids were joined to the main grid lengths using HDPE bodkins (rods). After this the grids were tensioned manually and fill material was deposited and compacted. In this way the reinforced fill was built up layer by layer. As work progressed the 20mm joint between the concrete panels was covered with a strip of 10mm thick non-woven geotextile. After something more than 1/3 of the height of the total fill had been deposited the wedges at the foot of the concrete panel were removed. At the foot the concrete panel moved forward less than 2mm. After about 2/3 of the fill had been deposited the braces were also removed.

The LandShape® is quick and simple to use and no special requirements are placed on the chemical composition of the fill material. Besides which the product distinguishes itself with an almost unrestricted potential for different facings. At the design stage the client can call on the knowledge and experience of Betonson and Civiele Techniek Nederland.