ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume LIX 43 Number 6, 2011

THE DESIGN PROCEDURE FOR PRE-GROWN STABILIZATION REINFORCED GRASS CARPET

M. Šlezingr, L. Foltýnová, V. Šulc

Received: January 18, 2011

Abstract

ŠLEZINGR, M., FOLTÝNOVÁ, L., ŠULC, V.: *The design procedure for pre-grown stabilization reinforced grass carpet.* Acta univ. agric. et silvic. Mendel. Brun., 2011, LIX, No. 6, pp. 355–358

Biological (or biotechnical) stabilization of banks based on the stabilization effect of grass has a fundamental disadvantage for reinforcement constructions and that is the delay in their functionality. It starts to be functional only several weeks after the sowing and its full function can be usually guaranteed for as late as the following vegetation period. Moreover, grass carpets on slopes forming banks of watercourses are damaged by erosion caused by the flow of water in the watercourse but also water flowing down the slopes. Other damage is inflicted by "trampling", i.e. the damage caused by the movement of people (anglers, rowers, hikers, etc.). This can be prevented to a degree by pre-grown grass carpets. These will bring about the stabilization effect sooner but the resistance of a pre-grown grass carpet is finally the same as when a suitable grass mixture is sown.
Therefore, in need of functional reinforcement significantly more resistant than a grass carpet, mostly stone or gravel riprap on the slope above the stabilization toe is designed.
The aim of the presented paper is to inform the professional public on the results of a design and a following application of a pre-grown stabilization reinforced grass carpet which, as stated by the producers, manifests a considerably higher efficiency against damage caused by water and trampling. It can replace stone or gravel reinforcement above the stabilization toe and the resulting construction (bank modification) fits better into the landscape.
So far, no similar construction has been designed within bank stabilization procedures in the conditions of the Czech Republic. The reinforcement is formed by suitable three-dimensional geosynthetics, in our case three-dimensional geonets.

stabilization of banks, reservoir, bank, erosive damage, geosynthetics

Appropriate bank stabilization is one of the essential preconditions for a successful design and following implementation of a modification of watercourse banks as well as water reservoir banks. Although the attempt during every revitalization is not to obstruct the creation of a natural stream channel, in a situation when the watercourse flows through an urban area, or there is a linear construction in the vicinity, etc., we have to employ an artificial stabilization of a stream channel or a reservoir bank.

The construction of reliable stream bank reinforcement is an indispensable part of permanent modification of the watercourse. Unless we want to use stone or gravel riprap above the stabilization toe, we only have a limited choice of possible solutions for reliable stabilization.

By the grant project IGA VUT FAST *Bank Stabilization* conducted under number FAST–S-10-82, we are trying to add another option to the range of suitable stabilization constructions, project MSM 621 564 8902.

The fundamental advantage of a stabilized reinforced grass carpet is the invisibility of the internal reinforcement in the stabilized area. Thus, only the grass carpet can be seen; however, the internal reinforcement (a suitable geonet) and the root system of the grass cooperate to bring about a higher efficiency of stabilization.

Design Procedure – Experiment (Materials and methods)

The basis is the selection of suitable three-dimensional geonets and grass mixtures. We made our choice on the basis of the range offered by the Geosyntetika, s. r. o. company. For further monitoring, after a careful consideration of all our needs (see below), we chose geonets ENKAMAT 7010 and 3 D Mat. [fig. 1, 2, tab. I, II]. These geonets fully satisfy our requirements, which were as follows:

1. Easily accessible in the Czech market.
2. Hygiene certificate guaranteeing harmlessness of the material when deposited in the soil.
3. The geonet has to be "three-dimensional", at least 1 cm, better 1.5 cm in height.
4. The geonet fibres are not fixed to a solid grid so that they can adapt to the growing roots.
5. The geonet will be able to perform its stabilization function for at least 10 years.

After the choice and procurement of suitable geonets we concentrated on the choice of the grass mixture which will be used for the sowing on the experimental plots. Again, we decided to give priority to a grass mixture that is available and composed of native grass species which have been verified for stabilization purposes.

The chosen grass mixture is "standard" with the following composition:

Lolium multiflorum „LOLITA“	20%
Lolium perenne „PIMPERNEL“	40%
Lolium perenne „BELIDA“	20%
Festuca rubra L. „MAXIMA“	20%

This will be used for the areas that are exposed to trampling, banks endangered by water flowing down or along (possible formation of rill erosion), etc.

Further, we used a meadow grass mixture, with the composition:

Phleum pratense „PHLEWIGLA“	23%
Lolium multiflorum „ROŽNOVSKÝ“	10%
Lolium multiflorum „LOLITA“	15%
Lolium perenne „TOVE“	25%
Triforium pretense L. „VLTAVÍN“	7%
Festuca pragensis HUDS. „LEVOČSKÁ“	20%

We assume this will be used in the areas outside urban areas, at bank transitions to the surrounding meadows.

As soon as the choice was accomplished, experimental plots were established in the area of "Žižkov". In the following description we focus on the combination of the both types of geonets and the "standard" grass mixture.

The procedure of plot establishment:

The base foil was covered in soil, about 3 cm thick; further, the Enkamat 7010 geonet was applied beside the 3D Mat geonet, both with the same dimensions – 1.2 m × 2.5 m. The geonets were covered in about 2 cm of soil and the "standard" grass mixture was sown. The seeds were then covered in a thin layer of soil and the entire sandwich construction was gently solidified. The plots were located on a flat area in half shade.

In the following days, the plots were watered and slightly maintained if needed. At this stage, the rooting was monitored, together with the gradual growing of roots through the geonets and the formation of the stabilized reinforced grass carpet.

The necessary maintenance of the experimental plots was performed for 5 months (trimming, watering, sowing of empty spots, etc.). As a result, there are properly rooted, vital stabilization grass carpets prepared to be used in the selected areas of the Brno Reservoir banks.

1: *The basic features of the selected geonet ENKAMAT 7010*

2: *The basic features of the selected geonet 3 D Mat*

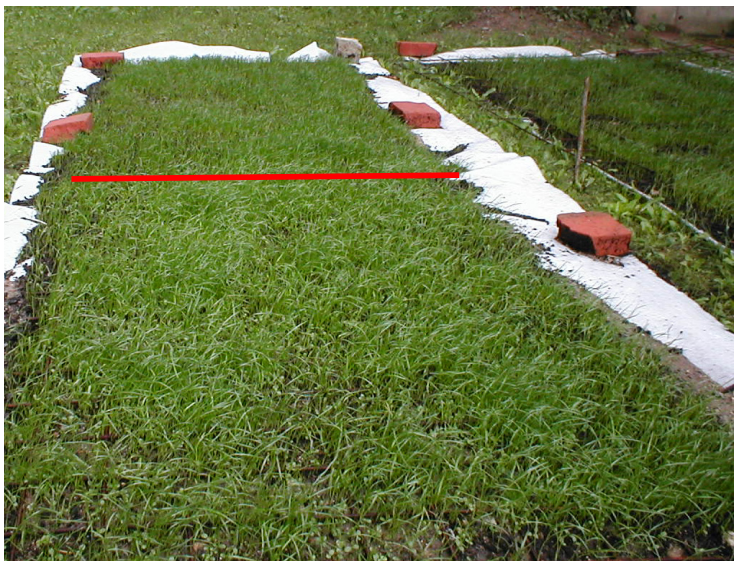
I: *Basic information about the geonet*

ENKAMAT 7010	
Tensile strength:	up to 1.5 KN/m
Thickness in mm	10 to 12
Weight	260 g/m2
Thermal resistance	–30 to 100 °C

II: *Basic information about the geonet:*

3 D Mat	
Tensile strength:	up to 1.9 KN/m
Thickness in mm	18
Weight	400 g/m2
Thermal resistance	–30 to 100 °C

3: *The procedure of the experimental plot establishment. Photo M. Šlezingr 5/2010.*



4: *The situation on the experimental plot after 3 months – there is an obvious vital grass carpet, no remarkable difference in the growth of the "standard" grass mixture in the area of the ENKAMAT 7071 or the 3 D Mat geonet. The red line shows the border between the two types of reinforcement (geonets). Photo M. Šlezingr 8/2010.*

RESULTS

Five months later (10/2010) we were able to conclude that we had achieved the goal – the reinforced soil stabilization carpet had been created. The entire sandwich construction was fully rooted through and the geonets had become – we can say – a part of the soil body. They work as soil reinforcement and together with the root system of the grass mixture they provide sufficient strength of the carpet when manipulated. The reinforced carpet can be lifted, transported, rolled without any risk of disintegration.

We can conclude that both of the used grass mixtures met the expectations; however, this was achieved by providing excellent conditions for their growth. Especially the regular trimming and watering of the grass carpet, and its plastic foil isolation from the lower bed, considerably reduced a natural succession of grasses.

DISCUSSION – FURTHER PROCEDURE OF THE EXPERIMENT

As soon as in autumn 2010 we assume that the reinforced grass carpets will be transferred to the banks of the Brno Reservoir, the Rokle area. Here, they will be laid on a selected part of the bank endangered by waves. They will thus become a part of abrasion protective stabilization of the bank. The efficiency of the reinforced stabilization grass

5: *An example of the rooting system – after five months, a reinforced soil carpet which could be arbitrarily handled formed. There is an obvious system of roots going through the sandwich construction Photo M. Šlezingr 10/2010.*

carpet will be compared with the efficiency of stabilization in the simpler form of a grass mixture sown on a modified slope, on a testing plot in the same area and with similar load conditions (water and trampling).

We are planning to monitor the development of the grass mass in natural conditions, without regular maintenance, the effect of the "reinforcement" on the soil stabilization and increase in bank resistance, the adaptation of the grass carpet to the natural environment and growth conditions, the ability to get involved in the protection of the bank in cooperation with surrounding stands.

This part of the experiment will be implemented in the following vegetation period, it means during the year 2011.

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Address

doc. Dr. Ing. Miloslav Šlezingr, Ústav vodních staveb, Vysoké učení technické v Brně, Žižkova 17, 602 00 Brno, Česká republika, Ústav tvorby a ochrany krajiny, Mendelova univerzita v Brně, Zemědělská 1, 613 00 Brno, Česká republika, Ing. Lucie Foltýnová, Ing. Viktor Šulc, Ústav vodních staveb, Vysoké učení technické v Brně, Žižkova 17, 602 00 Brno, Česká republika, e-mail: slezingr.m@fce.vutbr.cz, slezingr@node.mendelu.cz, foltynova.l@fce.vutbr.cz