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RESEARCH REGARDING THE USE OF GEO-SYNTHETICS TO CONSOLIDATE THE FOREST ROADS' ROADWAY

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Abstract: *Within the present paper the uses of geosynthetics for the consolidation of carriageable forest roads from the Sfantu Gheorghe Forestry Department are presented. In the case of Pava and Hanko III roads, the use of geogrids located at different structure levels of the road system was experimented; the experiments from Husaus road involved the possibilities of using geotextiles and geocellules. References related to the execution technology, costs and behavior of the experimental road sections under traffic conditions are pointed out.*

Key words: *road system, geotextiles, geocellules.*

The geo-synthetics are last-generation industrial products, obtained from an advanced treatment of plastic material that are generally used for road construction and whose usage has been extended to forest roads' construction.

The series of geo-synthetic materials used is very large, from geo-textiles, used for draining and insulating purposes, geo-membranes for sealing, geo-grilles reinforcing, geo-networks for draining and anticorrosive protection to geo-composites that can fulfill multiple function, depending on the component materials.

The interests for using geo-grilles for forest roads' construction in our country are relatively recent, respectively after year 2000 and the experiments have been conducted separately both by INL (Institutul Naţional al Lemnului - The National Wood Institute) and by *Transilvania* University throw the teachers involved in this project. In what concerns the *Transilvania* University in Braşov, these experiments were preceded by a well-defined theoretical-applicative documentation made during a doctorate's thesis [2].

In the following, there are presented some of the aspects resulted from the research made by the teachers from the forest roads' discipline at the university. Furthermore, it can be mentioned that the first research sighted using geo-grilles to reinforce road's layers and took place on the forest roads administrated by Direcţia Silvica Sf. Gheorghe, technically-assisted by the geo-grilles supplier (IRIDEX Bucureşti). The experiments took place on forest road's ramification - Hanko III and on Pava forest road.

As for the experimental road sectors, there were variants in the way the geo-grilles

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have been placed, variants that were finally compared with the forest road's reinforcing variant that did not involved using geo-materials (the basic variant or variant 0).

Thus, the geo-grilles were placed, according to the adopted variant, under the macadam lay of the road, under the road's stone layer of under the ballast layer, respectively at the roadbed's level. Also, it has been tried to reduce the sub-grade's thickness when geo-grills were used in the road's structure (Figure 1).

To the present day, the experiments made with geo-grilles are few, thus not allowing to firmly concluding something. Anyway, the observations made along the time permitted these following conclusions:

- using NETLON H 12-CE 131 geo-grilles with a tensile strength of 5.8 kN/m is indicated to low-traffic forest road, with under 10000 t/year;
- generally, assembling the geo-grilles is easy, but choosing the type of material to use should be done according to an efficiency criteria and should not depend on the material's price;
- extending the geo-grilles into the forest roads' construction should be continued with further experiments, in different terrain conditions and using different types of geo-grills or even different types of geo-synthetics.

In what concerns the traffic endurance for the experimental road sectors, after years of usage, the following conclusions could be taken:

- after two years, the road structure suffered several specific deformations such as: ramparts, holes, furrows and degradation caused by the freezing-thawing cycle. The amplitude of these defects was greater for the road sector that was not equipped with geo-grilles than the ones reinforced with geo-grilles, regardless their position on the road;
- the costs for maintenance and repairs were substantially lower for the sectors with geo-grilles with 80-90%, and the extra costs for implementing these geo-grilles can recovered after 4-5 years.

The researches regarding the use of geo-synthetics to reinforce the roadways for forest roads have continued with the ones made in the interval 2005-2006 and are still continuing.

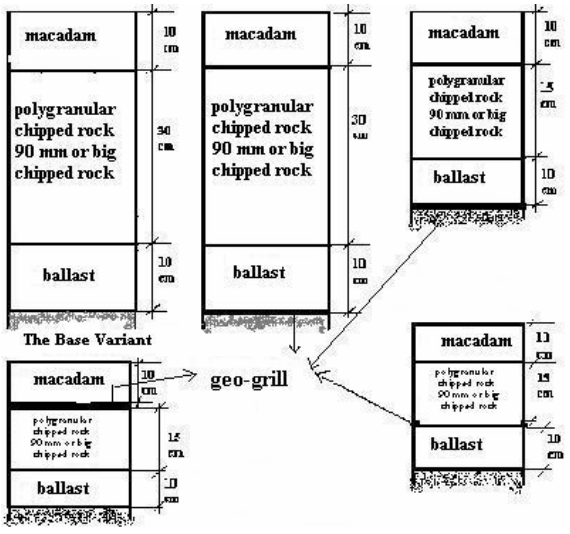

Fig. 1. *Geo-grills in the road's structure*

The new experiments made sought using geo-textiles and geo-cellules, special synthetic materials used for draining and sealing, respectively for reinforcing. Conjunctly with The National Forest Regie, it has been chosen for experimenting the Husăuş auto-forestry road, from D.S. Sf. Gheorghe, O.S. Comandău. In 2005, there were made several experimental road sectors, with different consolidating structures witch are presented in Figure 2 (including the basic road sector - the consolidation sector from the project).

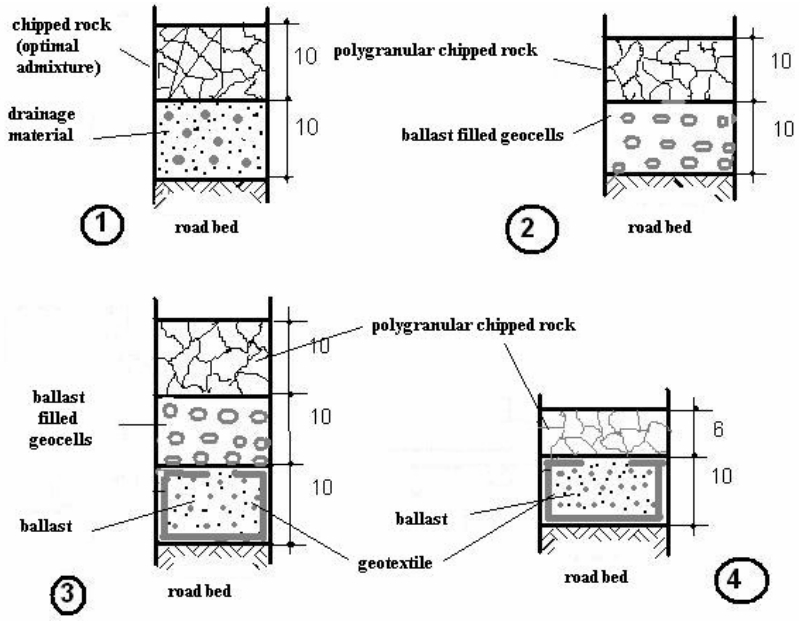

Fig. 2. *Experimental road sectors, with different consolidating structures*

As it can be observed, the mark variant, initially designed in the project, also called "status quo" variant, with a length of 40 m, has its road structure made out of two layers, each with a thickness of 10 cm: a sub-grade made out of draining material and the blanket made out poly-granular stone (optimal mixture). The experimental variants have the following structure [1]:

- variant 2: the sub-grade is made out of geo-cellules, filled with ballast and the blanket made out poly-granular stone, each layer having a 10 cm thickness, on a length of 40 m;
- variant 3: the road structure is reinforced using three 10 cm thick layers: a ballast substratum which is covered in geo-textile, a sub-grade made out of geo-cellules filled with ballast and a blanket made out poly-granular stone, on a length of 31 m;
- variant 4: the road structure is made two layer: a 10 cm thick ballast sub-grade, covered in geo-cellules and a 6 cm thick poly-granular stone layer.

It must be mentioned that the experimental sector, including the status-quo variant were all placed in alignments of in curves with big radius, having a declivity smaller than 5% in order to ensure similar traffic conditions and to eliminate (or reduce) centrifugal force's effects found on sector with greater declivities.

The geo-synthetic-based road layers' construction has lead to specific construction technologies that are less known and presented in forestry literature.

Therefore, to construct the road layer made out of ballast and covered in geo-textile (variants 3 and 4), the following step was made:

- the roadbed, that was previously smoothed through the entire width of the platform, was covered with 5 m wide geo-textile material; this material was covered with ballast (only on the roadway's width - 4.19 m wide on average); as a caution, the trucks that carried ballast were not to "step over" the geo-textile before the ballast had been spread over;
- the ballast was manually spread, with prescribed 10 cm thickness, after which the geo-textile's edges, that exceeded in width with 40 cm the ballast layer on both sides of the runway, was bent over the ballast layer, thus partially covering the superior ballast layer (Figure 2);
- the rolling was made using a compactor so that it would "step" only the ballast layer, without "stepping" over the geo-textile-bent edges; these edges would have been subsequently rolled together with the road's blanket;
- finally, carpeting the road's blanket which would have 10 cm after rolling.

As for the ballast-filled geo-cellules (variants 2 and 3), the construction method was the following one:

- the 2.75 m wide geo-cellular was spread and anchored using metallic bridles over the support layer (the sub-grade's base) so that it would integrally cover the roadway (2.75 m in width); after that, the ballast was manually spread and was used to fill the alveoli; the 10 cm thick ballast layer was spread all over the platform's width and exceeded in thickness with 4 cm the 6 cm high alveoli from the "honeycomb-like structure" of the geo-cellular material;
- thus there have been obtained: a roadway reinforced with ballast and geo-cellules two bordering lanes made from ballast, which can be used as road verges;
- the rolling, made with the compactor, was finally made through all the platform's width, including the verges.

As for the other layers, made from granular materials, the classical construction technologies were used.

It must be used that the synthetic materials used were delivered as rolls, in the case of geo-textile, respectively as 8 m long pleated coils in the case of geo-cellules.

It can be underlined that width of the material delivered at the construction site, there has not been a problem of "sawing" the material or "overlapping" it.

As what regards the traffic endurance for the experimental road sectors and the comparison made with the "status quo" solution, these sectors are still to be observed and the conclusion will be taken after a minimum 1.5-2 year period, in a future paper.

References

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