Geosynthetics: Applications, Design and Construction, De Groot, Den Hoedt & Termaat (eds)
 ISBN 90 5410 836 3

Design-technological decisions using geosynthetics in reconstruction of the Moscow Ring Road

Yu.Lvovitch, Yu.Aliver & A.Kim
Soyuzdornii, Moscow, Russia

ABSTRACT : Reconstruction of roads, especially around big cities (megapolices) such as Moscow, is associated, as a rule, with considerable difficulties, which are conditioned by the existing infrastructure of the adjoining territory. The main problems arising in this case require a search of nonstandard decisions for building the equally strong road constructions adjoined the lanes operated.

Domestic and foreign experience of using geotextiles and other geosynthetic elements made it possible to propose and already to use some range of advanced constructions and technologies for various conditions encountered during reconstruction of subgrades and road pavements. In this case the questions associated both with providing the road structure reliability and with the possibility to construct them within the time envisaged by the project were considered.

From the standpoint of theory, the use of geosynthetics was based on the following principles: the role of geotextile elements on the basis of the results of a preliminary geotechnical evaluation of elements of the technogenic soil mass; determination of a composite (soil-geotextile material) layer position in the structure and conditions of its work during operation; requirements to the range of geotextiles used; the development of specifications for physical-mechanical properties of geotextiles.

On the basis of the results of such theoretical approach to each earth structure of the highway reconstructed, the required range of geosynthetic materials, including continuous geotextiles based on polypropylene; glass-fabric geonets treated with the latex or bitumen compositions; volumetric geogrids made from high-strength polyethylene; volumetric draining materials, was developed.

The volumetric draining materials involve a specific high-porosity core made from the polypropylene melt and a protective envelope made from continuous geotextile material (130 to 150g/sq.m) based on polypropylene with a filtration coefficient of 20m/day. The width of volumetric material is 0.5m. It is delivered in specific ribbons 25 to 30m long formed in rolls. Continuous geotextile materials based on polypropylene from 1.70 to 2.40m wide had the density of 350 to 500 g/sq.m. They were used for a wide range of earth structures. The biggest amount of geotextile material was provided for reinforcing the clayey subsoils before constructing the embankments and making the draining layers in cuts. Since the embankments and draining layers were made from sands with a filtration coefficient of 0.5 to 4 m/day, the continuous geotextile interlayers also served as separating and draining layers on the sand and clayey soil contact. Due to this the interlayers had to meet the requirements in terms of strength, water permeability and water conductivity with taking account of subsequent conditions of structure service. The expedience of applying reinforcing elements from continuous geotextiles in the subgrade was established on the ba-

sis of a geotechnical assessment of the foundation clayey soils. At first the assessment was fulfilled by means of a penetrometer of a static o dynamic action and then by means of an impeller on the design horizons. The relative density (compaction coefficient) of clayey soils of natural deposit was determined according to the results of penetration, and the conventional shear resistance was determined by an impeller.

If the range of values were lower than 0.0073 MPa, then, according to Russia specifications, the foundation clayey soils were classifed as weak soils. In this case the alternatives of removing such soils and their subsequent replacement with draining soils or their reinforcing by geotextile interlayers were considered. The requirements to reinforcing elements were established depending on the stratum of weak soils and their shear resistance. In this case one considered the following conditions of work of the composite bottom layer formed (weak clayey soil-geotextile interlayer - sandy soil): to make provision for its bearing capacity under the action of loads created by building machines and compacting equipment and to make provision for the road pavement stability at subsequent operation. The bearing capacity was controlled by the application of geotextiles of different strengths and deformabilities, and also by an appropriate thickness of the first sand layer filled on the geotextile interlayer.

The thickness of the layer depending on the values of the physical-mechanical properties of sands and the character of compactability of these sands was in the range of 0.3 to 0.8 m.

In some cases for providing a reliable adjoining of the embankment being constructed to the existing structure, "the benches" cut in this structure during the reconstruction of earth structures on the viaduct and bridge approaches were reinforced. In this case the geotextiles 1.70m wide with the density of up to 500g/sq.m were applied.

During reconstruction the problem of the water removal from the exposed drainage layer of the structure being reconstructed was acute. The drainage of an old sand layer and the removal of underground water accumulated were carried out using several types of drainages based on continuous and volumetric geotextile materials: area and radial drainages.

Special attention to the use of geosynthetics was paid in stabilizing the embankment slopes and the cone surfaces during reconstruction of the Moscow ring road. These structures made from sandy soils needed an immediate protection against deformations associated with the water and wind erosion. To realize protective measures, two types of constructions, namely, the glass fibre geonets with the cell size of 5 x 6 mm and 10 x 12 mm and the geogrids of Geoweb type were used. The first type of constructions was considered as temporary measures. The geonets intended for the protection and preservation of topsoil with grass seeds for the period of the grass cover formation. The second type of constructions was designed for providing the local stability of the embankment slope 20 sq.m high. The embankment length is 200m, the area of the surface stabilized is 8000 sq.m. The slope is divided by a berm; the lower part of the slope has the grade of 1:1.75, the upper one - 1:1.5. The bed of the open spillway reinforced by the plastic geogrid is in the lower part of the slope. The construction of slope stabilization is a flexible cellular geogrid cover filled with the topsoil with grass seeds. That cover was made so that it provides protection of the shoulder, the upper part of the slope, the banks and the open spillway bed against erosion deformations. Separate elements of the construction are fastened together by anchors. Bearing steel anchors fasten the whole system to the slope surface ensuring the joint work with the surface layers of the soil. The same decision was used in the case of stabilizing the viaduct cones.

To provide the reliability of the construction in combination with geogrids, the geotextile material based on the polypropylene of domestic production was used and the cells were filled with the granite crushed aggregates and the ce-

ment concrete mixture.

In more difficult cases occurring due to the unexpected engineering-geological conditions in the process of the reconstruction of the Moscow ring road, the multilayer construction based on the polyethylene geogrids and geotextile materials in rolls was developed.

The use of such construction is envisaged for reinforcing weak foundations in constructing high embankments, places of conjunction of the new subgrade with the slope parts of the road operated, and in some other cases.