PRODUCER'S REVIEW

OF THE CONSTRUCTION OF ROAD FOUNDATION AND SURFACE

concerning the construction of roads with a metalled-surface

Customer: TABOSS 48-303 Nysa, ul. Nowowiejska 21

Phase: Producer's Review

Author: Rafał Łukomski, MSc Eng.

Wrocław, February 2008

1. Application of Geo-grid TABOSS in road construction

The concept of closing loading construction materials inside a light, spatial, flexible and at the same time optimally resistant geosynthetic allows a new approach to designing and implementation of structures used in soil stabilisation and reinforcement. The cellular geosynthetic system in question has found a wide application in:

- reinforcing weak soil bases;
- solving construction problems in complex soil-water conditions characteristic to steeply-sloping banks and hillsides;
- securing rivers, canals and water reservoirs;
- constructing embankments, drainage systems and temporary roads leading to building facilities
- The basic element of the system is comprised of sections of cellular geo-nets (also known as geo-grid) made of dozens of appropriately connected (ultrasonic welds) high density polyethylene tapes.

In a spread position, the lay-out formed by connected tapes takes the shape of a flexible structure resembling a honey comp, which can be filled with a certain material; in a closed position, the section is formed by a layer made of dozens of polyethylene tapes. The sections are produced in different cell sizes and dimensions.

TABOSSYSTEM® - the working mechanism of the system in a horizontal position. When the geo-grid is unrolled on an adequately prepared base and the loading material filled and properly thickened (break-stone, gravel, all-ups, sand, slag, etc.), a certain load is applied to the geo-grid. The stresses transmitted from a wheel of the vehicle (or the load) result in an increase in vertical stresses in material filling the geo-grid cells, which increases the forces of pressure on the cell walls. The geo-grid's elastic tape takes over a certain part of those forces, whereas the remaining part, pushing the adjacent cells, helps generate the forces of resistance (passive pressure) in those cells. The cells, collaborating with each other in the spatial structure of the geo-grid, cause permanent thickening of the material filling the geo-grid and bring to cooperation large areas of the base, which considerably reduces the scope of vertical stresses locally transmitted to the base ("like the spatial construction of steel bridges"). Mutual blocking of the cells virtually prevents moving of particular elements of the geo-grid and limits its uneven setting.

The application of Geokrata Taboss brings the following effects:

- reduced thickness of road structures, as opposed to conventional solutions, thanks to the application of a spatial system, which eliminates deep soil replacement;
- considerably increased resistance of the materials filling the geo-grid on the wall as result of their closure, reduction and significant densification inside the cells;
- reduced setting caused by natural densification and limitation of the side moving of the aggregate filling the geo-grid;

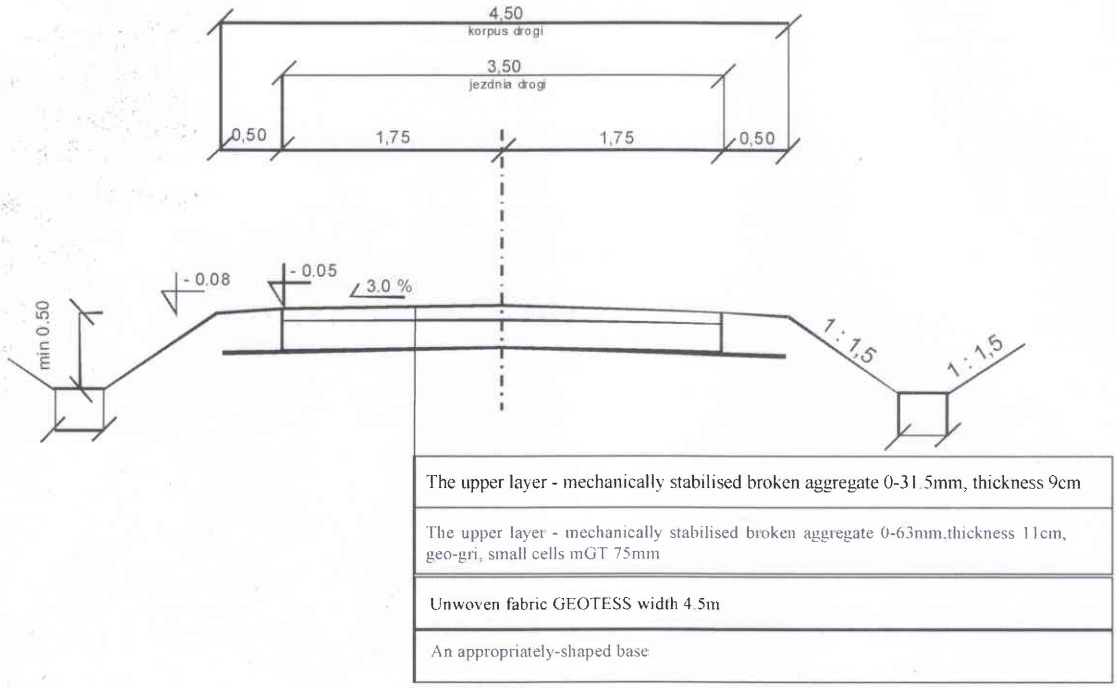
- reduced stresses transmitted to the soil base from the useful load affecting the surface as a result of laying out the concentrated loads to adjacent cells of the geo-grid;
- formation of a road construction with a specified load capacity with no need to remove rainwater (a rain drain system, a surface run-off system); the surface layer is comprised of loose materials enabling filtration of rainwater through the road base layer.

Taboss Company recommends the following solutions when constructing a road with a metalled-surface:

Standard solutions with the application of Geosynthetics to construct a road base for different soil types. However, to implement the project successfully, two basic requirements must be met: the road base constructed according to the recommendations and an appropriate choice of the geosynthetics' parameters. In general, taking into consideration the types of soil in Poland, three kinds of **TABOSSYSTEM** solutions were identified, depending on the soil type:

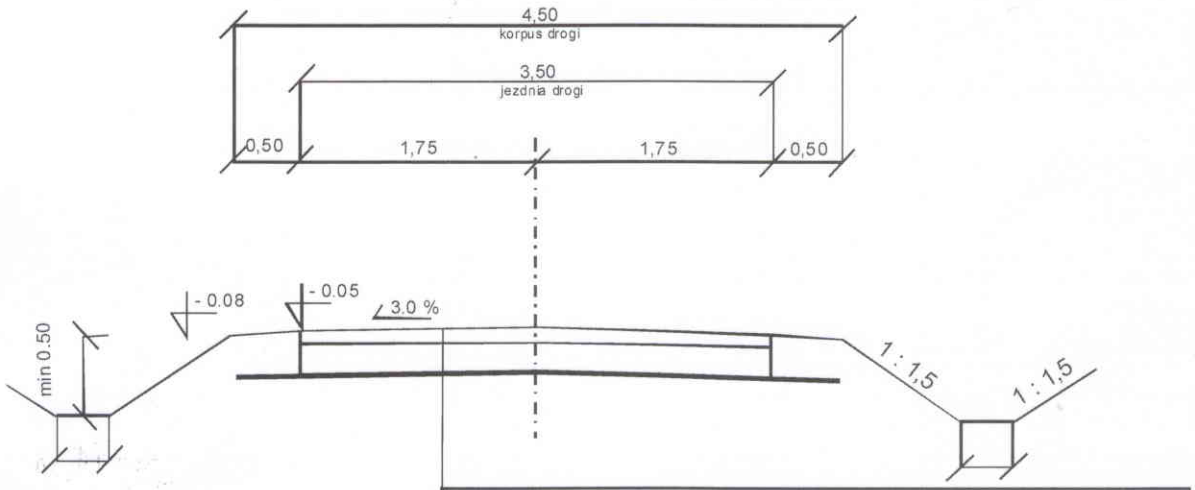
1. ***TABOSSYSTEM for a good soil G1*** – for solutions planned for good soils classified as G1, the following cross-section should be applied:

1. The very bottom, after being trenched, will be covered with a geo-unwoven fabric ***GEOTESS TC/PP 150 GRK3*** – constituting a separation layer, preventing the aggregate from absorbing to the base, and a filtration layer, allowing free flow of water and gases, at the same time retaining the aggregate and preventing it from being rinsed.
2. After installing GEOTESS, you should unroll the TABOSS geo-grid – 7.5cm-high and of medium dimension of a cell;
3. Then the geo-grid is filled with approx. 11cm layer of 0-63mm appropriately thickened aggregate;
4. The final phase – mechanically stabilised abrasive aggregate layer 0-31.5mm and 9cm-thick.



2. ***TABOSSYSTEM for a good soil G2*** – for solutions planned for good soils classified as G2, the following cross-section should be applied:

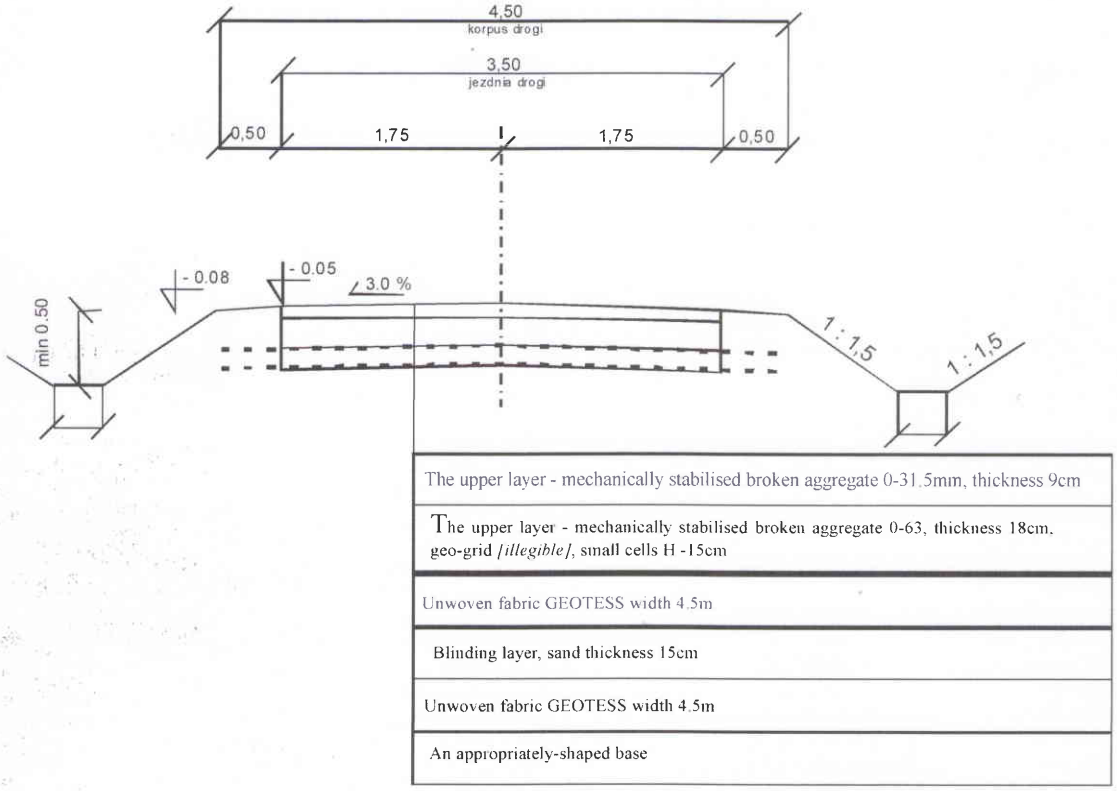
1. The very bottom, after being trenched, will be covered with a geo-unwoven fabric ***GEOTESS TC/PP 250 GRK4*** – constituting a separation layer, preventing the aggregate from absorbing to the base, and a filtration layer, allowing free flow of water and gases, at the same time retaining the aggregate and preventing it from being rinsed.
2. After installing GEOTESS, you should unroll the TABOSS geo-grid – 15cm-high and of medium dimension of a cell;
3. Then the geo-grid is filled with approx. 20cm layer of 0-63mm appropriately thickened aggregate;
4. The final phase – mechanically stabilised abrasive aggregate layer 0-31.5mm and 9cm-thick.



The upper layer - mechanically stabilised broken aggregate 0-31.5mm, thickness 9cm
The upper layer - mechanically stabilised broken aggregate 0-63mm, thickness 20cm, geo-grid, medium cells GT MK 150mm
Unwoven fabric GEOTESS width 4.5m
An appropriately-shaped base

3. ***TABOSSYSTEM for a weak soil G3-G4*** – for solutions planned for good soils classified as G3-G4, the following cross-section should be applied:

1. The very bottom, after being trenched, will be covered with a geo-unwoven fabric ***STRADOMGEO 19*** – constituting a separation layer, preventing the aggregate from absorbing to the base, and a filtration layer, allowing free flow of water and gases, at the same time retaining the aggregate and preventing it from being rinsed.
2. A gravel sand layer 15cm
3. Then ***GEOTESS TC/PP 250 GRK4*** unwoven fabric - constituting a separation layer will be applied.
4. After installing GEOTESS, you should unroll the TABOSS geo-grid – 10cm-high and of medium dimension of a cell;
5. Then the geo-grid is filled with approx. 15cm layer of 0-63mm appropriately thickened aggregate;
6. The final phase – mechanically stabilised abrasive aggregate layer 0-31.5mm and 9cm-thick.



These systems are ready standard solutions – facilitating the choice of materials, installation and operation of the system. It should be noticed that the above division can be applied to soils classified in terms of load capacity as G1 and G4.

A short characteristic of soils allowing their classification

Selecting a solution regarding geo-synthetics is determined by terrain and geotechnical conditions. Depending on the initial soil parameters – usually identified by a geodesist – a solution based on geosynthetic materials is selected. The following types of soil base are identified:

Soil characteristics		
Soil classification	Type of soil	Description of soil
G1	Non-swelling soil: gruss (non-loamy), gravel and gravel sand, coarse- medium- and fine-grained sand, compact slag	Generally soil which after short rain do not prevent passenger vehicles from driving, but intense traffic causes ruts
G2	Uncertain soil: dusty sand, loamy decomposed rocks and gruss, loamy gravel and gravel sand;	Soil where passenger traffic under good conditions causes degradation and ruts, normal exploitation is impossible without reinforcement
G3	Soil not particularly subject to frost-heave*: compact clay, sandy and dusty compact clay, loam, sandy and dusty loam;	Soil with very limited resistance, where, regardless weather conditions, ruts are created, the only possible traffic – by 4x4 drive off-road vehicles
G4	Soil strongly subject to frost-heave*: loamy sand, sand dust, dust, clay, sandy and dusty clays, varved loam	Generally soil preventing 4x4 drive off-road vehicles, inaccessible for wheel traffic

The term "soil subject to frost-heave" refers to soil which widen more intensively during freezing.

The above-mentioned soil type were arranged according to their load capacity – from the best to the worst – marked as G1, G2, G3 and G4. Their capacity is in addition determined by the local water conditions, e.g. the load capacity in the case of uncertain soil can be classified as G1, G2 and G3 depending on the local water conditions.
Therefore, to classify the existing geotechnical conditions of the base in a clear and comparative way, an analysis of the CBR load capacity of soil is carried out on a soil appropriately saturated with water, as required by the norms.
Then, based on the measured load capacity, the soil analysed can be classified to one of load capacity types – beginning from the best G1 and ending at the worst G4:

$$10\% < CBR - G1\ soil$$
$$5\% < CBR < 10\% - G2\ soil$$
$$3\% < CBR < 5\% - G3\ soil$$
$$CBR < 3\%\ G4\ soil$$

In the case of G1 and G2 soil types, standardised solutions can be applied, as their initial load capacity is good and there is no risk of landslide or susceptibility to frost-heave. In the case of

soil with load capacity classified as G3 and G4, consulting a geotechnician is recommended, who help thoroughly analyse the situation and select the right solution since additional reinforcements with the use of a wide range of geosynthetics and as well as a drainage system might be needed.

ECONOMIC ASPECT OF APPLYING TABOSSYSTEM IN ROAD CONSTRUCTION

The application of TABOSSYSTEM results in reduction in costs by lower trenching and consequently, reduction in the road base thickness, which allows saving the aggregate, retaining the same, and usually achieving even higher base resistance. Eight years of experience in fire road construction in the Polish forests let one assume that reducing the base to a layer below the freezing zone does not exert a negative influence on the road structure.

REQUIREMENTS CONCERNING THE CHOICE OF MATERIAL TO FILL GEO-GRID TABOSS

Geo-grid Taboss used for loading (direct foundations, roads, vehicle manoeuvre areas, etc.) should be filled with grained materials (grained loading materials)
The fine-grained fraction going through #200 i.e. 75um should not apply more than 10% volume, since with the plastic fraction amounting to over 10% it has a low permeability, and rapidly loses resistance if saturated with water.
The best solution is grained material such as unsorted gravel or sand in which the fraction #200m does not constitute more than 8%.
Generally speaking, the fine-grained fraction #200m should not exceed 2/3 of the fraction closer to #40, it is essential that the natural moisture indicator in the #40 fraction is not higher than 25%.
The degree of plasticity should be lower than 6%.
The friction angle for the thickened grained material should be between 30-40 degrees.