VEGETAL COVERING IN CUT SLOPES BY MEANS OF GEOCELLS OF RUBBERIZED SISAL BIOBLANKETS IN BRASILIA/DF, BRAZIL

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INTRODUCTION

The strongly wavy relief transposition for implantation of highways has became intensely used in the last decades by means of tunnels, cuts and fillings, causing impacts to the landscape in result of some factors, as decapitation of surfaces, abrupt transformation of land morphology, disequilibrium of superficial and sub superficial water circulation, waste handling sistems, enchainment of erosive processes etc.

As an alleviating measure of part of the impacts generated for the excavations for constructing the roadways, procedures of containment and vegetal resetting of surfaces for reduction of the erosive processes and stabilization of mass movements are adopted. The found terrain are very diversified and several occasions the vegetal covering becomes difficult in reason of the physical-chemical characteristics for germination to be inadequate. In areas of high risk to the occupation with stability problems, commonly they use covering with projected concrete for containment of hillsides, that parallelly causes strong environmental and visual impact in the intervention area, and furthermore, possibly, not consisting in solutions duly adequate or definitive for these situations.

The search for alternatives is frequent in academic medium as much as in the private initiative for techniques for containment of hillsides and more economic erosion control, looking for lesser ambient impacts and better results. The search of these alternatives gradually becomes technically systemizing itself, aiming at the recovery of the conditions of dynamic balance of the impacted landscapes due to the explosive increase of social and environmental problems intrinsically related.

In this direction, it will be presented the description of a work of vegetal covering by grass in plates, antierosive bioblanket and geocells in fibers of rubberized sisal for the confinement of soil in cut slopes of a highway in Brasilia/DF, in Brazil. This technique presented excellent results and it shows promising for use in other works of containment of hillsides and erosion control.

LOCALIZATION OF INTERVENTION AREA

The intervention area comprises two cut slopes with inclinations of about 35º, 30,000m² approximately, constituted of barren silt material, located in the Park Dom Bosco (EPDB) highway linking to Park Contour (EPCT) highway, with an access over Paranoa Lake by the Juscelino Kubstichek bridge, South Lake, in Brasilia/DF, Federal Capital of Brazil (Figure 1).

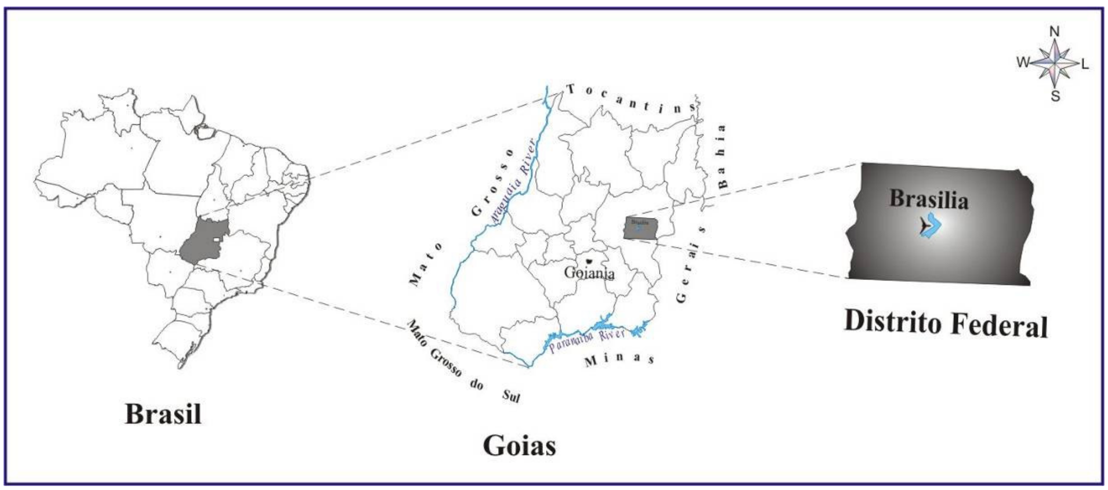

Figure 1 - Localization of the intervention area.

ABOUT GEOCELL

The use of geocells (three-dimensional alveolar structures for soil covering) retraces to the decade of 70, being developed by the Body of Engineers of the American Army (U.S. Army Corps of Engineers) in partnership with the company Presto Products Co, and demonstrating itself as an excellent alternative for the confinement of materials (soil, sand, concrete, etc.) for the transformation of surfaces as required.

Nowadays geocells are produced and commercialized in polyethylene of high density (PEAD) in form of panels consisting of a set of adjoining cells. The cells are formed joining 60 strips 1,25 mm thick and 75, 100, 150 and 200 mm width, joined between themselves for 10 or 11 welds. When extended in the ground each cell measures 200x225 mm (8”x9”) normal or 400x462 mm (16”x18”) double.

Many materials can be confined in geocells panels, as to the necessity or objective of the work, such as sand, broken stone, soil, concrete etc. Its implantation does not demand specialized man power and the complementary materials are only setting metallic poles or, eventually, reinforcement cables when the use of the poles is not possible.

However, there is another way for manufacturing geocells with good quality alternative materials. It consists of the confection of the three-dimensional alveolar structures using rubberized sisal bioblanket whose heights and widths are projected accordingly to the objective of the intervention. The characterization of this material and its use will be described to follow.

CHARACTERIZATION OF MATERIALS AND WORK EXECUTIVE METHODS

In the beginning of the year of 2004, the works of excavating for construction of the linking highway EPDB/EPCT and its paving had been concluded. Extensive cut slope surfaces were displayed to erosion and a strong visual/environmental impact was installed (Figures 2 and 3).

Figure 2 - Sight of cut slopes in highway EPDB/EPCT after concluded the excavating services.

Figure 3 - Sight of cut slopes in highway EPDB/EPCT after concluded the pavement services.

Auction process was opened by Novacap (responsible agency for Brasilia gardening), whose object consisted of the implantation of technique for the cellular confinement of soil and vegetal covering of the slopes surfaces, these constituted by barren silt material and with strong declivity.

After winning the auction, the services immediately has been initiated, consisting of the elaboration of the geocell project taking in account the geocell height, the declivity and lengths of slopes, the weight and the angle of attrition of the filling material (Figure 4).

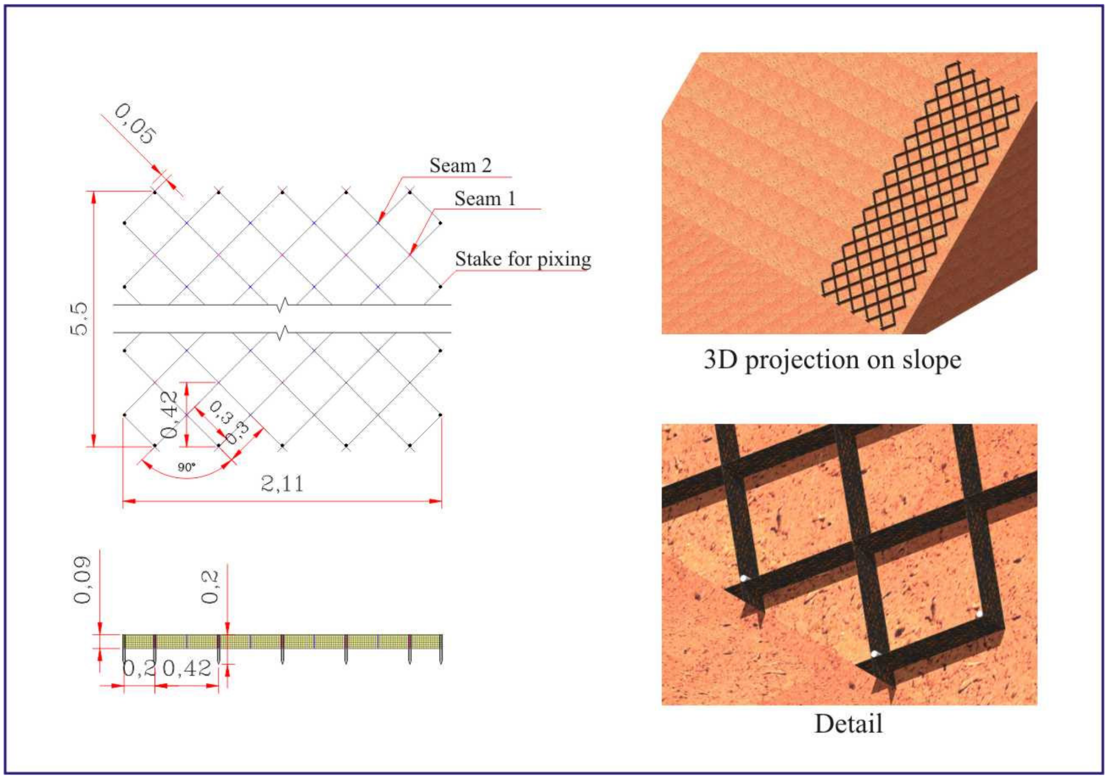

Figure 4 - Project of rubberized sisal geocell.

Sisal bioblanket Geofiber® GF/30S (700 g/m²) was used, with the following characteristics (Picture 1):

TECHNICAL SHEET- BIOBLANKET GEOFIBER GF/30S			
Description of the assays	***Norm***	***Value***	***Unid***
Density	EN 965	> 700	g/m²
Longitudinal tensile strength	EN ISO 10319	> 85	kN/m
After the aging cycle of 430 h	EN 12224	> 75	kN/m
Transversal tensile strength	EN ISO 10319	> 40	kN/m
Longitudinal deformation at maximum load	EN ISO 10319	6.5	%
After the aging cycle of 430h	EN 12224	5	%
Transversal deformation at maximum load	EN ISO 10319	10.5	%
Mesh dimension	EN 918		Mm
Roll dimension: 2.00m x 50.00m (6,5'x165')			

Table 1 - Characteristics of Bioblanket Geofiber GF/30S.

Geofiber® GF/30S Bioblanket presents great longitudinal tensile strength (85 kN/m) as much as transversal (75 kN/m), and still with a little decrease after aged, what is satisfactory for biodegradable products. We then conclude that it is a good material for temporary superficial consolidations, where the vegetal development is the main stabilizing agent of the mass movements.

Bearing in mind that bioblanket presents moderate deterioration by weather (sun and rain) and biological agents, it was necessary to cover the sisal yarn with rubber, in order to improve the mechanical properties, durability and handling, this last because its parts had been cut in uniform bands and sewn manually.

The main idea was that of manufacturing a product for soil confinement, that not necessarily would have to be permanent, therefore the vegetal development of the grassy ones would be charged on to stabilize the top soil layer. This procedure was also evaluated to reduce or to fit costs because the available financial resources were limited in relation to the grandiosity of the work.

After the beginning of the production of geocells the works started, consisting of the regularization of the erosive ridges and inversion of declivities of benches by land filling (Figure 5). Some group of benches converged the pluvial draining to the underlying slope what it would cause installation of erosive ridges, in case the declivities were not inverted redirecting the flows for the draining narrow channels.

Figure 5 - Process of surfaces regularization by filling.

Later had been extended the panels of geocells and settled with metallic poles (Figure 6), with posterior argillaceous top soil filling (Figure 7) having as essential equipment two cranes and two backhoes. After regularization of surfaces parts of bioblanket (Geofiber® GF30/S without rubberizing) had been extended, to help the material confinement (Figure 8). Furthermore, bioblanket possess some peculiar positive properties to the vegetation when used for ground superficial protection: it has antierosive function by softening up the splash effect and even the hydrical drainage; it helps in humidity retention, by forcing the water infiltration and reducing evapotranspiration; it reduces the seed loss and helps the aggregation of organic substances to the ground, favoring the microbiological development and restructuring the ground. The creeping vegetation establishes very quickly in these conditions.

Figure 6 - Installation of panels of geocells in rectified slopes.

Figure 7 - Filling of geocells with argillaceous top soil.

Figure 8 - Application of antierosive bioblanket Geofiber® GF30/S.

Finally, the Batatais grass (Paspalum notatum) in plates had been planted over the bioblanket (Figure 9) and propped up with bamboo for preventing displacements on the steep slopes.

Figure 9 - Plantation of grass in plates over the bioblanket.

This technique allows that some stages of the services along the slope are executed concomitantly. To synthesize this procedure, Figure 10 illustrates the 5 basic stages of the work.

Figure 10 - Synthesis of the stages of implantation of geocells and plantation of grass: 1) regularization of slopes; 2) implantation of geocells; 3) filling with top soil; 4) application of bioblanket in sisal; e 5) plantation of grass.

Figure 11 shows the concluded work. After some days, during the rainy station, the NPK fertilizer launching was carried through to assist the vegetal development.

Figure 11 - Conclusion of the work.

FINAL CONSIDERATIONS

Besides having been rigorously executed under the technical criteria and having presented excellent results, the work also presented positive results in the following aspects:

- as it was objectified the temporary superficial consolidation, until the full root development to of Batatais grass, geocell in sisal became economically more viable than conventional products. In short, the geocell in sisal fulfilled the technical expectations projected;

- as to the environmental aspect, the use of bioblankets in vegetal fibers has presented as ideal for erosion control works of and as coadjuvant in works of hillsides containment, for being a biodegradable material, or either, that it goes interacting with ground, assisting significativelly the vegetal development; and

- the incentives to the production, commercialization and application of products derived from sisal fibers contributes for the social development by generating jobs in the three first economic sectors, not demanding specialized man power. The production of yarns (of sisal, coconut fiber etc) is associated with the utilization of its raw materials in a sustainable way, mainly in the case of coconut, which husk is abundant in Brazil and entirely discarded in form in residue.

It is standed out that little is known in Brazil about the use of biodegradable materials for the erosion control and on helping in the recovery of vegetation of degraded areas. Some materials are known that also use other fibers, like the coconut, bamboo, rice straw, buriti leaves etc. The improvement of these materials and the techniques of their application is however advised, through research and fields experiments. These procedures certainly will contribute for the social and environmental development, generating jobs and income in the production, heating the economy, and mitigating the environment liabilities caused by land degradation.