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Brazilian experience on soil reinforcement: Two Case – Histories

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ABSTRACT: Soil reinforcement techniques have been used in Brazil since the early seventies. Large geosynthetics reinforced retaining structures were initially built in the early eighties and their use has been increasing since then, particularly in the last 10 years. This paper presents two particular case-histories of geosynthetic reinforced retaining walls built in the last two decades. One of the case histories is a reinforced structure that might be considered rather high for the time it was built and the other, although low, was built on a very compressible foundation soil.

1 INTRODUCTION

The use of reinforced soil structures in Brazil dates back to the early seventies, with pioneer works on soil nailing with quite daring designs for the state-of-the-art in those days (Ortigao et al., 1995). The use of soil nailing in Brazil was a natural extension from the use of anchored retaining wall in the country since the 50's. The use of geosynthetic reinforced retaining structures and steep slopes began in the early 80's with geotextile reinforced retaining walls in highway applications. This paper summarises information on two case histories of geosynthetic reinforced walls.

2 CASE HISTORIES

2.1 *The SP-123 Highway Embankment Repair*

A geotextile reinforced structure was used for the repair of a 30 m high road embankment failure in the SP-123 highway, in the state of Sao Paulo, Brazil, in the early eighties (Carvalho and Wolle, 1986). The reinforced mass was 11m high and approximately 50m long. The total face area was 500 m^2. A silty sand was used as fill material. Two types of geotextiles were used in this wall for research purposes. In the first half-length of the wall a nonwoven, needle-punched, geotextile made of polyester was employed. In the second half-length of the wall a woven geotextile, made of polypropylene, was used. Both geotextiles are rather extensible reinforcements. The spacing between reinforcements layers in both cases was equal to 0.6 m. Figure 1 shows the cross-section of the slope after the repair.

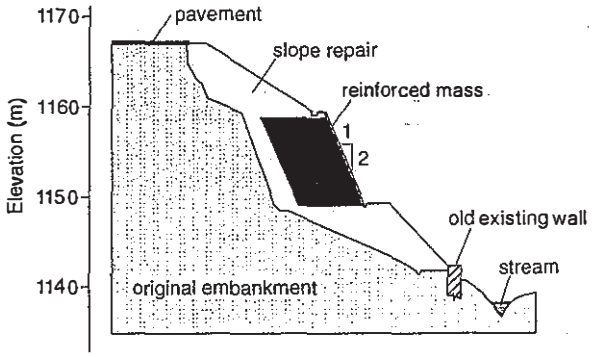

Figure 1. Cross-section of the SP-123 Embankment Repair

Figure 2 presents comparisons between costs of different solutions for the repair of the slope. It can be seen that the use of geotextile yielded to the cheapest solution, with significant cost reductions (DER-SP, 1986).

After almost 20 years in service, the slope repair has been performing very well, with negligible face displacements of the reinforced mass being observed during this period.

2.2 *Geosynthetic Reinforced Abutment on Soft Soil in the Linha Verde Highway*

The Linha Verde highway runs along the coastline of the Brazilian Northeast region. It is very important to that region for economical and tourism reasons. In several parts of the highway length rather deep layers

of soft soils can be found, particularly in crossings of local rivers. Geotextile reinforced bridge abutments were used in several of these crossings (Palmeira and Fahel, 2000 and 2001). Most of these reinforced abutments were built on piles with caps to reduce settlements. In one of the cases, in the abutments for the crossing of the Sauípe river, the reinforce mass was built on a 4.5 thick clayey sand layer overlying a 5.7 thick layer of soft clay, as shown in Figure 3. The designers decided not to use piles and caps under the reinforced abutment in this case. Although low (2m high), this abutment was built on difficult foundation conditions and provided important lessons on the effects of large settlements on the behaviour of reinforced structures.

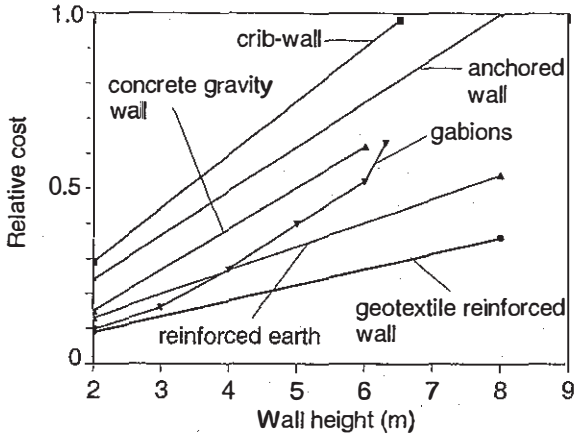

Figure 2. Comparison between wall costs.

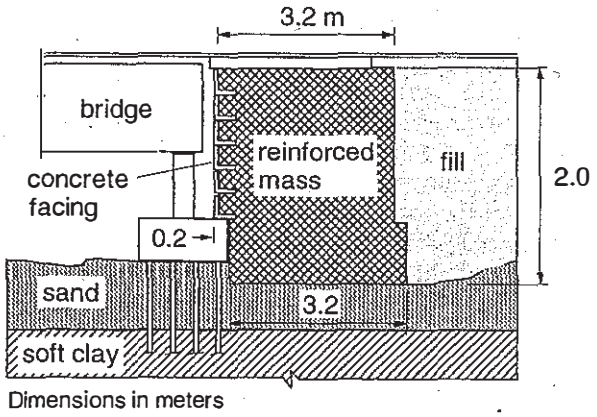

Figure 3. Sauipe River geotextile reinforced bridge abutment.

A nonwoven, needle-punched geotextile was used as reinforcement in the Sauipe river abutment. The spacing between reinforcement layers was equal to 0.3 m and fine sand was used as fill material.

Because of the presence of the soft soil foundation layer, significant differential settlements were observed in the reinforced abutment, despite its low height. Figure 4 shows some damages to the abutment face units ("L" shaped precast units). The maximum horizontal displacement at the wall crest reached 55 mm. The total settlement of the wall face was equal to 0.29 m.

In spite of the significant differential settlements observed, the flexibility of the reinforced soil abutment proved advantageous in minimising damages and, after initial repairs, the wall has been performing well up to the present date.

Figure 4. Wall face rotation and damages.

4 CONCLUSIONS

This paper summarised the performance of two case histories of geosynthetic reinforced structures. Geosynthetic reinforced walls and slopes up to 28m high have been built in Brazil up to date (Martins, 2000). The use of this type of structure in Brazil will certainly continue to show a significant increase in the coming years.

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