PLANTED WALLS REINFORCED WITH HIGH STRENGTH POLYESTER GEOGRIDS: HIGHWAY FROM MADRID TO LA CORUÑA IN LUGO.

Iñaki Amigot
Huesker S.A.

INTRODUCTION

The technique of using soil reinforced with geosynthetics consists in the inclusion of these materials, with the intention of obtaining a material which is more resistant and less deformable than soil on its own.

The use of reinforced soil goes back a great number of years, when our ancestors used roots mixed in with the soil. Examples of these applications can be seen in the Bible, the Great Wall of China, the roads to the Inca Temples, and works of the Roman Empire. For reasons that are unknown, the technique was forgotten for hundreds of years. In the 20th century, there were a few sporadic applications, and the technique of using reinforced soil has been revived with increasing vigour since the 1960s.

Industrial development in the area of new materials has meant that geosynthetics have become an excellent and economical technical solution for reinforcing soil. The inclusion of geotextiles and geogrid reinforcement in soil makes it possible to construct retaining walls using different systems and with different finishes.

CONCEPT

A planted wall, also known as a green wall, is made up of layers of compacted soil interspersed with horizontal sheets of geotextile or geogrid reinforcement. Thanks to these geosynthetic reinforcement materials, it is possible to construct embankments of reinforced soil, even with vertical slopes, with a surface finish of plants, fully integrated into the environment.

REINFORCED EARTH WALLS ON THE N-VI HIGHWAY, VILLARTELIN TO CEREIXAL SECTION

These planted walls were constructed in the section from Cereixal to Villartelin on the Northwest Highway, part of the National Road No. VI from Madrid to La Coruña, which passes through a landscape of very steep hillsides

converging down into a narrow river valley, known as the River Neira Canyon, which is a tributary of the River Miño in the province of Lugo in Galicia.

The Spanish Ministry of Development decided to construct geogrid-reinforced planted walls. *Dragados y Construcciones* was the company that carried out the work. The height of the walls varies between 10 and 25 metres. The slope of the walls is 83 degrees.

WHY PLANTED WALLS IN THESE ROAD CONSTRUCTION WORKS?

There were three main reasons for adopting this wall system:

- The high ecological value of the area through which the highway runs led the owners to consider the idea of constructing the retaining walls using a system that could reduce the environmental impact of the result. It was necessary to achieve the highest possible integration of the structures in the vicinity.
- The 20 metres of height that some of the walls measured made this wall system very appropriate.
- The foundations of some of the walls rested on infill materials, which required that the wall system adopted should not transmit high pressures at its base.

THE DESIGN OF THE WALLS

Starting with the parameters defining the infill material, the bearing capacity of the base, and the existing additional loads, the result of the calculation determined the thickness of the earth layers, and the length and nominal strength of the reinforcing geosynthetics used.

A stability calculation of the embankments defines the working tensions existing at each point, in accordance with the general safety coefficient which is adopted.

The nominal strength of the geogrid should be reduced by factors intrinsic to each reinforcement material to define its working strength. These reduction factors allow for the creep of the polymer material and the mechanical and environmental damage which the geogrid will suffer in each case, for a design life of the wall of 120 years.

The way to avoid the possible uncertainty that the use of these safety coefficients generates in the market is based on the use of geogrids which bear an independent certificate of approval of these values. With these certificates, the project engineer had the confidence of having designed a wall with the required levels of certainty and safety.

In these works, the reduction factor adopted was 2.82, thanks to the use of high tenacity polyester geogrids, protected against mechanical damage by a polymer coating.

CONSTRUCTION PROCESS

The construction process of the planted walls consisted of spreading a layer of infill material with a section of topsoil in the area of the final surface of the wall. Both types of soil were thoroughly compacted. Then the geosynthetic of the specified length was spread out to wrap each layer. The result, after a succession of layers, was a reinforced embankment with layers of geosynthetic material which is stable under the loads for which it is designed.

The finish of the outer face of the walls was more than satisfactory. The use of external shuttering of the Orleki type made this finish possible, at a very reasonable cost, and observing safety criteria for the operating staff.

GEOGRID REINFORCEMENT

The geosynthetic reinforcement was subject to strict quality control procedures. The public authorities under the responsibility of the Engineer required certificates of approval of the geogrid. A wall of more than 20 metres in height, property of the Ministry of Development, which is a retaining wall of the National Road no. VI must be perfectly designed and the materials employed must be perfectly monitored and guaranteed. More than 300,000 m^2 of Fortrac® geogrids were used.

The geogrids used have a very high modulus of elasticity, a low deformation in breakage, and very low creep. The loss of strength of the geogrids subjected to continuous load over time should be very low.

It should be abundantly clear that if the behaviour of a particular type of reinforcing material over time is unknown, it should not be used in the construction of this type of structure. This gives greater importance to the need to know the characteristics of the material, always through certificates of approval, to meet the serious possibility of uncertainty which exists as a result of the novelty of these materials.

DRAINAGE

Both the contractor and the Engineer were very clear about the importance of correct drainage of reinforced structures. Every effort was expended to collect the underground and surface waters, to go about their removal, and thus to avoid the presence of pore pressures in the infill.

Drainage in this type of wall is a fundamental aspect of guaranteeing the stability of the structure.

FINAL PLANTING

The immediate planted finish was achieved by carrying out hydroseeding on the wall face with a suitable mix of seeds which germinated within a period of 15 days, and gave an initial appearance of total coverage.

The choice of seeds, and their concentration and composition, was specific for each wall, depending on the slope and orientation of the wall. In order to achieve a full plant cover over the longer term, it was recommended to plant bushy and creeping plants at the base and along the crown of the wall, plants which should be capable of putting out roots over the entire length of their stems.