Coastal protection of Figueira da Foz Dune

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ABSTRACT: Due to the constant change of climate, the erosion on coastal areas is increased caused by big storms, challenging man to protect land trough efficiency solutions. The use of geotextile construction elements offers economical, efficient and flexible solutions, contrary to massive and cost intensive structures made of concrete, steel or rock.

1 INTRODUCTION

Because of crescent erosion in Portuguese coastal, caused by a lack of sediments, among other, is necessary, nowadays, to implement technical solutions to minimize his effects. One off these cases is the south dune of Leirosa beach, in a fragile position after the construction of an emissary from the paper factories around.

After some sand reinforcements that failed after big storms, was decided to implement a soft solution with geotextile reinforcement in 120 m long.

The installation of geotextile as reinforcement solution is a real case of geosynthetics use.

2 WRAP AROUND SYSTEM

The solution adopted in 2005 consisted to construct a shelter to the front of the dune, through the overlap of seven layers of sand wrapped in geotextile - "wrap around system". To protect the foot of slope, and to prevent the loss of sand to a lower level, was installed a row of geotextile bags, filled with sand, forming a pyramid set.

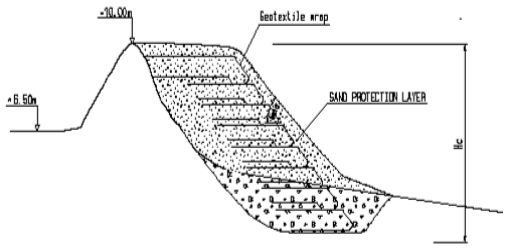

Figure 1 - Cut the dune, with involvement of the layer of sand

The geotextile, as a filter material, not woven fabric, needle punched, with a properly open size, allows the hydraulic flow of seawater, keeping stable the sand inside. Its design took into account the need to absorb the energy caused by the action of the waves, resisting the drag of the sand.

Figure 2 - Installation of the bottom layer with bags of sand

In 2006, after heavy storms, there was a great loss of sand in the 3 bottom layers on the dune, caused by the opening of some overlap of geotextile. Not having been found unable to resist any of the material, it was found that in these layers, the geotextile as been applied in conditions of strong wind and a big humidity, it was not perfectly welded, causing the collapse of the base of the dune.

3 APPLICATION OF GEOTEXTILE PIPES

The solution adopted in 2008 for strengthening, was the installation of geotextile tubes in large-scale: 20 m long by 1.6 m in diameter, with a capacity of 40 m^3 of sand, applied in 5 layers overlapping. These pre-manufactured tubes of 1,000 g/m^2 geotextile, have characteristic opening appropriate to a filtration function, as well as flexibility and strength required for the function of retention of the sand. The filling process is the pumping of water and sand from the sea, using appropriate equipment (pump dredging).

3.1 *Preparation of the fill geotextile tubes*

In order to protect the erosion of the base of the dune during the filling of tubes, was installed a geotextile with 600 g/m^2. This geotextile avoid the erosion of sand from the base of the support tubes.

Figure 3 - Application of geotextile for protection

As part of stabilization, profiles in concrete were installed, for filling in a secure way. These profiles are taken when the tubes are completely filled with sand, and moved in the position of the next tube below.

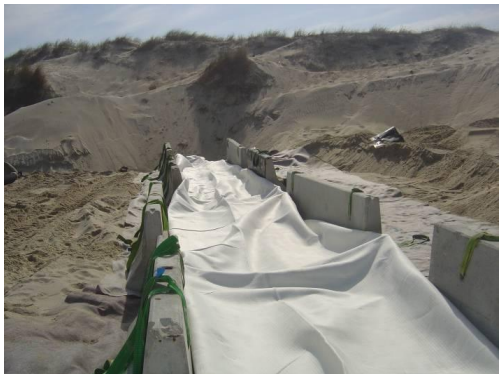

Figure 4 - Implementation of the profiles and tube

3.2 *Procedure for filling the tubes*

After the unroll of the tube to the correct position, with the mouths of entry and exit position to its upper part, it is the installation of the hose of entry, from the pump. It also installed a hose-out in the area opposite the tube, which control the flow of drainage water and consequently the amount of solids deposited inside the tube.

This is done by filling pump 900 m^3/h of flow, reduced to about 500 m^3/h, initially only with sea water until the complete filling and adequate positioning of the geotextile tube.

Figure 5 - Fill the bag with water

In the continuous process is started by filling with solids by pumping water and sand (maximum 20%). The water continues to be drained by the geotextile and the output mouth, while the sand was retained inside the tube, until the complete filling. The relationship between the quantity of fine sand and greater granulometry allows a constant filling without "clogging" of the tube, which are difficult to release.

In the end, the mouths of entry and exit of each tube is completely closed. This procedure takes about 4 hours for each tube.

Figure 6 - Placement of tubes in 1 layer of protection

The whole process is repeated again for the next tube, which overrides the previous approximately 1 m, until complete 120 m in the front and 20 m meeting ends.

Figure 7 - Positioning of the tubes

Figure 8 - Filling the upper layers

The layers are placed following disagreements with the tubes of the layer immediately below, indented on this in order to establish the initial slope inclination of the dune.

Figure 9 - Implementation of the beds above

3.3 *Final coverage and landscaping*

In the final layer of about 1.5 m in height (top layer), and to ensure the containment of the sand between the tubes and the existing dune, was applied a horizontal layer of geotextile bags, which sewn with appropriate equipment, allows the execution of a large bag (21 m x 6 m). It was installed in a structure of containment geotextile to involve the entire dune, ensuring retention of the sand during the storm periods.

Figure 10 - Implementation the bag top

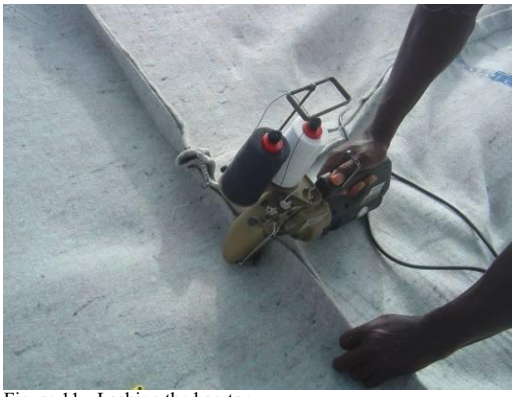
Figure 11 - Lashing the bag top

To protect the structure of tubes installed, was made the cover with 1 m of sand in order to proceed with the planting of vegetation suitable to the area and contribute to environmentally intervention area.


Figure 12 - Cover with sand

4 CONCLUSION

The increasing need for intervention in coastal areas to reduce erosion caused by sea, makes the search for technically sustainable, economically viable in opposition to old and heavier structures, as stone or concrete.

The use of geosynthetics, geotextiles in particular, may be an option with great technical and economic advantages for the intervention in coastal areas, due to its high permeability and resistance.

Besides the intervention described, many other solutions can be implemented with geosynthetics, given the great ease of handling and installation, such as, for example, the implementation of artificial reefs in coastal front, using the tubes with the appropriate size to resist the action of the sea.


Figure 13 - Direct action of the sea on the tubes