

## Executed project report

### Slope consolidation in the Palangrers Beach (Roses, Girona)

**Stakeholder of the project:** Naturalea

**Execution:** Naturalea

**Client:** Rosersa

**Start and finish:** February - March 2018

BEFORE



AFTER



#### INTRODUCTION

Palangrers beach is one of the most important beaches in Roses. The quality of the seafront contrasts with the slopes. These are near to the road and river walk, and have stability problems with impacts on the surface runoff, and presented some provisional solutions of low quality landscape.

The present intervention has solved the slopes problem while gaining landscape quality. To achieve this, landscape bioengineering techniques have been used in a remarkable intervention because it has been done in front of the sea. It is one of the first projects at European and probably global level where techniques such as the crib wall have been used in an area so close to the sea using typical species of these areas and local helophytes.



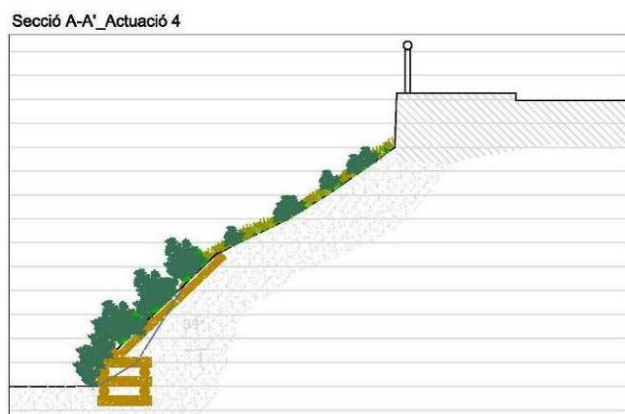
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## Executed technical proposal

### **Action 1. Consolidation of a slope at the nearest point of the beach next to the south access zone.**

It is an area treated directly from the beach with active erosion. As the lower part of the slope was lowered, it collapsed, and progressively more important slopes were generated.



It is an area of **9 meters long** with a practically vertical slope of 2 meters high and a slope about 45 degrees 4 meters long and below.

In order to create the right conditions for the development of the plant, a base of a crib wall and a slope grid in the upper area has been implemented.





Images of the intervention before and after:



Detail of the foundations:



Naturalea cribwall:





Slope grid during the construction:



Images of the finished action:







Detail of the used plant species:

Plant	Cribwall	Slope grid
	Uts	Uts
<i>Tamarix gallica</i>	39	8
<i>Vitex agnus-castus</i>	25	2
<i>Pistacea lentiscus</i>	8	8
<i>Myrtus communis</i>		19
<i>Cistus salviifolius</i>		10
<i>Cistus monspeliensis</i>		10
<i>Rosmarinus officinalis</i>		9
<i>Olea europaea sylvestris</i>		6
<i>Juniperus phoenicia</i>		6
<i>Rhamus alaternus</i>		8
<i>Santolina chamaecyparissus</i>		7
<i>Ammophila arenaria</i>		8
<i>Pancratium maritimum</i>		10
<i>Sporobolus pungens</i>		9
	72	120

## Action 2. Consolidation of a slope at the beach next to the north access zone.

A section of **11 meters** corresponding to a slope of sand has had the base stabilized to prevent the zone from being eroded, and later more suitable species have been introduced in this area. Up to the upper part, there is a slope of an average height of **8 meters**, which means a total area of **88 m<sup>2</sup>**.



A treatment similar to the Action 1 was done to a slope that suffered a landslide by the construction of stairs.

Detail of the used plant species:

Plant	Palisade	Slope
<i>Tamarix gallica</i>	5	
<i>Vitex agnus-castus</i>	3	
<i>Pistacea lentiscus</i>	2	
<i>Myrtus communis</i>	5	8
<i>Cistus salviifolius</i>		5
<i>Cistus monspeliensis</i>		5
<i>Rosmarinus officinalis</i>	2	5
<i>Juniperus phoenicia</i>		5
<i>Santolina chamaecyparissus</i>		15
<i>Ammophila arenaria</i>	5	20
<i>Pancratium maritimum</i>	5	5
<i>Sporobolus pungens</i>	10	20
	37	88



Images before and after the intervention:



Initial situation of the zone:



Construction process:







Final result:





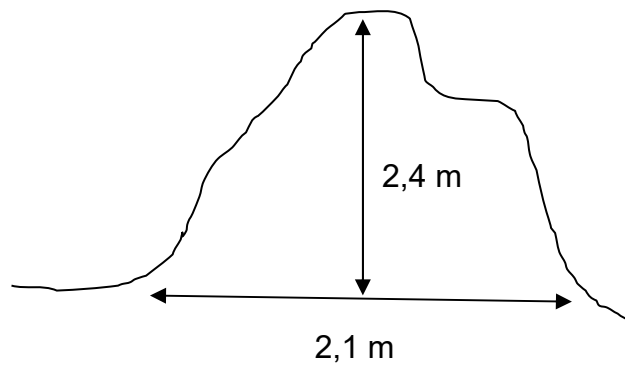


### Action 3. Consolidation of a small landslide

This intervention is located in a small stretch, where erosion was active between two rocky areas. The stretch has a width of 2,1 meters, and goes 2,4 meters inside the slope. Stabilizing the first 1,2 meters the erosion can be stopped.

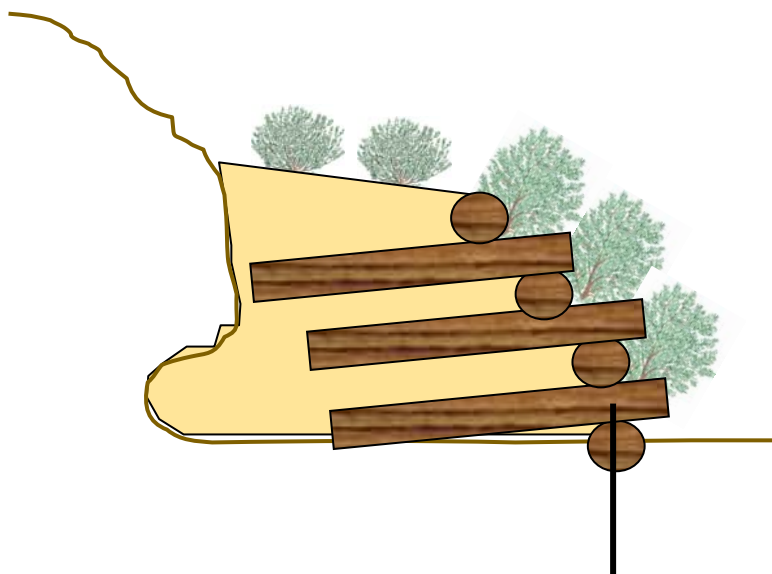


Viewed from above:



A simple crib wall of 1,2 m was built in a wall that occupies all the space between the two rocks (2,1 meters). It allows the fulfilment between the structure and the rocks, protecting the base (the weakest part of the slope).

Scheme of the intervention:





Detail of the used plant species:

Plant	Crib wall	Plain
	Uts	Uts
<i>Tamarix gallica</i>	15	0
<i>Vitex agnus-castus</i>	9	0
<i>Pistacea lentiscus</i>	3	0
<i>Myrtus communis</i>		3
<i>Rosmarinus officinalis</i>		2
<i>Juniperus phoenicia</i>		2
<i>Santolina chamaecyparissus</i>		3
<i>Ammophila arenaria</i>		2

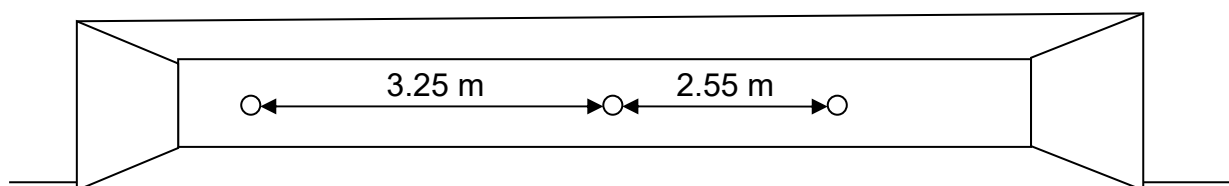
Final result:



#### Action 4. Consolidation of the south zone with a breakwater

It is one of the two areas with more erosion problems, contained by the presence of a breakwater on the front. The length of the current breakwater was 9.3 meters but in fact, relocating the platform, a structure has been placed 1,2 meters ahead, so that the structure has 15,4 meters following the majority profile of the zone.

This structure consolidates the entire section of the base of the street wall, so the projection behind the intervention has an impact on an area of 11,3 meters. These 11,3 meters correspond to a section where the street makes a small cantilever and at the bottom of the wall three drainage pipes are located. This fact is incorporated in the design of the solution, which in addition can mean an interesting water contribution of the waters that emerge from the drainage tubes.





Images of the zone:



The solution consists in two lines of double crib wall or Naturalea-type Krainer. Between crib walls and in the top part the new profile was stabilized with seeding mat (in slopes with a 50 degrees slope). The slope is more pronounced in one of the margins, where palisades were made to improve the consolidation of the contributed soil.



Detail of the used plant species:

Plant	Cribwall	Slope grid
	Uts	Uts
<i>Tamarix gallica</i>	106	8
<i>Vitex agnus-castus</i>	76	2
<i>Pistacea lentiscus</i>	10	10
<i>Myrtus communis</i>		23
<i>Cistus salviifolius</i>		18
<i>Cistus monspeliensis</i>		13
<i>Rosmarinus officinalis</i>		14
<i>Olea europaea sylvestris</i>		7
<i>Juniperus phoenicia</i>		12
<i>Rhamus alaternus</i>		11
<i>Santolina chamaecyparissus</i>		15
<i>Ammophila arenaria</i>		50
<i>Pancratium maritimum</i>		10
<i>Sporobolus pungens</i>		72
	192	265

Image before the intervention:





Image after the intervention:



Preparation of the foundations:





### Lower crib wall:



### Upper crib wall:





Palisade in construction:



Installed seeding mat:

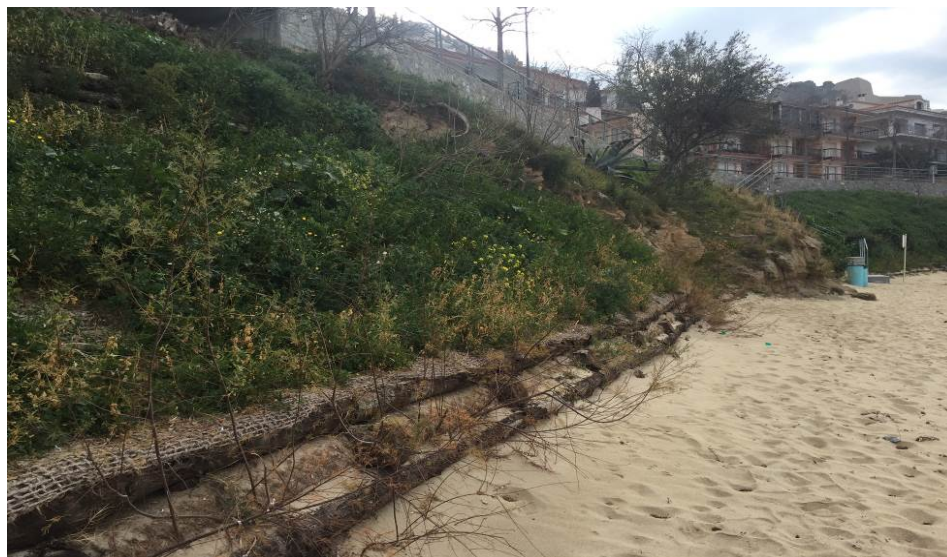




Vegetated construction:



General view of the interventions:



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**KEY WORDS:** litoral slopes, landscape bioengineering.

**APPLIED TECHNIQUES:** simple crib wall, Krainer crib wall, Slope grid, Vesubian slope grid, palisade, seeding and seeding mat.