CONTRIBUTION OF GEOLOGY FOR NATURAL ENGINEERING WORKS

Study Case Cape Mondego (*Aspiring Atlantic Geopark*)

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ABSTRACT

Sustainable solutions are increasingly important and must cover all areas, therefore it is imperative to adopt sustainable procedures such as the methodologies based on Natural Engineering, allowing the stabilization and rehabilitation of ground masses with potential safety risks. Consequently it is essential to proceed with a suitable classification and characterization of the massifs, in order to assess their safety factor so that they can be effectively intervened, making sustainable and cost-effective choices. The Cape Mondego area was once used for the exploitation of limestone, marly, limestone and marl rocks, and the remaining environment scars require a broad intervention to recover those areas.

Keywords: Aspiring Atlantic Geopark; Cabo Mondego; Classification and characterization of slope; Natural Engineering; Rehabilitation; Safety Factor; Stabilization; Sustainable Geotechnics.

INTRODUCTION

There are increasing concerns about climate change, which directly interfere with geology and more specifically with the stability of massifs, causing their weathering and landslides.

Modifications in coastal areas significantly affect the behavior of local massifs located there, through the action of abrasion and erosion due to the dynamics of the sea, which can provide unstable cliffs and endanger the surrounding environment (eg:. Roads or buildings).

It is important to use geomechanical classifications such as the Rock Mass Rating (RMR) and the Slope Mass Rating (SMR) or characterization indices such as the Geological Strength Index (GSI) to understand the behavior of rock masses and define their geotechnical parameters, so that later measures can be taken to stabilize and rehabilitate the slopes and cliffs.

For stabilization and rehabilitation environmental aspects, and the use of Natural Engineering methodology will be taken into account.

Figure 1 – Location of Cape Mondego Natural Monument (Rocha, 2010).

STUDY AREA

The study area is located in Cape Mondego, in the municipality of Figueira da Foz, district of Coimbra, Portugal, and consists of three abandoned quarries which have not undergone recovery and rehabilitation. Rocks along or near the coastline are weathered and unstable, currently in a degraded state, needing intervention.

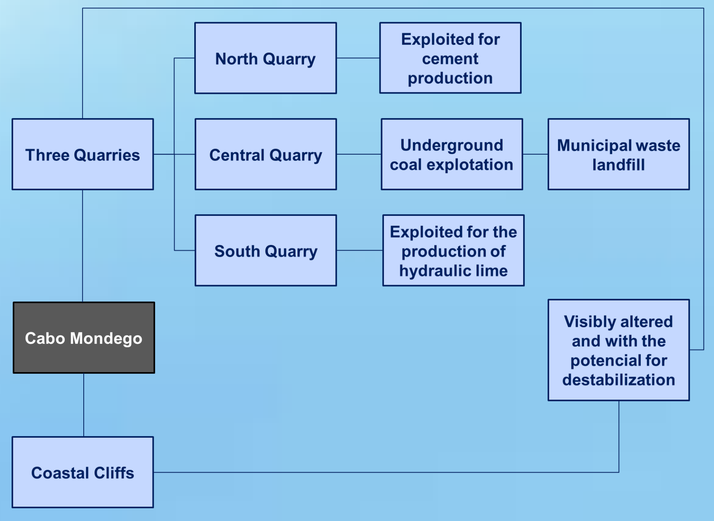
The study site belongs to the Cape Mondego Natural Monument, which is a integral part of the Aspiring Atlantic Geopark, in the vicinity of area to be intervened. There are communication routes and abandoned buildings that can constitute dangerous situations.

The Cape Mondego belongs to Meso-Cenozoic sedimentary series, and is composed by limestone, marly limestone and Jurassic marl alternations (Rocha, 2010). The further we move north, the greater the marly predominance.

OBJECTIVES: CARACTERIZATION AND CLASSIFICATION OF THE GEOMECHANICAL BEHAVIOR OF THE GROUND MASSES, AIMING THEIR STABILIZATION AND REHABILITATION WITH NATURAL ENGINEERING METHODOLOGIES

In order to fulfill the general objectives, beginning with the collection of information about the study area at a geological, structural, geomorphological and hydrological point of view; to identify in detail the local geology and relate it to the geographic; and historical conditions of the place; adapt the methodologies of description and characterization of the geomechanical behavior of geological material. eg:. BGD (Basic Geotechnical Description), RMR, SMR, GSI; determinate the geotechnical conditions and safety factors of the site; create a geotechnical model and present Natural Engineering solutions that rehabilitate and stabilize massifs according to local characteristics.

MAIN RESULTS OF THE PRELIMINARY ASSESSMENT



In all the places mentioned there is no maintenance and the signs of abandonment are visible. The exploitation of geological resources ended, in part due to the geological and paleontological heritage existing in Cape Mondego, which was classified as Natural Monument and has global importance (Goulão, 2016).

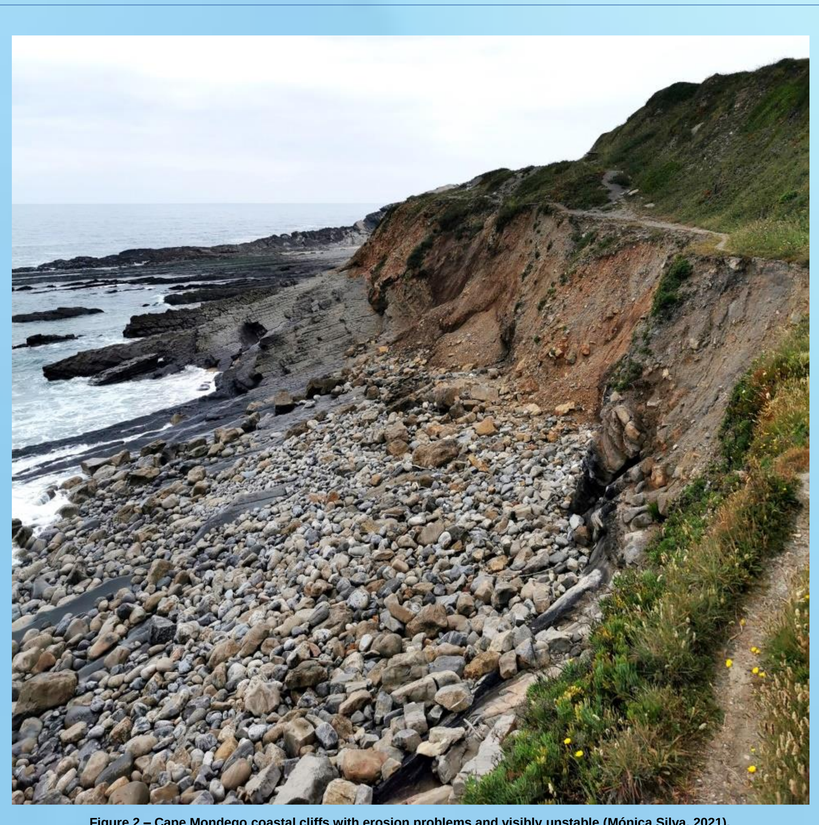


Figure 2 – Cape Mondego coastal cliffs with erosion problems and visibly unstable (Mónica Silva, 2021).

EXPECTABLE RESULTS

It is expected to find solutions that promote a balanced and functional rehabilitation of the exploitation area integrated with the natural surrounding space, enhancing and valuing the two components, seeking efficient and competitive solutions.

Solutions integrating living material as buildings materials (eg:. seeds, plants, plant parts and pant associations) will be proposed and also the use of products made from recycled material, mainly quarry waste, to increase the protection against erosion, flow control, microclime, biological, ecological and landscape quality of the intervention areas.

Some procedures intended to be adopted based to the geotechnical results are: seedbeds; organic blankets; sowing and planting; linear plantations; living thresholds; living drains; walls and grids of vegetation.

Limitations in the use of these techniques are expected, essentially in the treatment of rock masses, however alternative ways to respond to the limitations will be investigated.

The greatest expectation is to use Cape Mondego as research project in Portugal of joint use of Natural Engineering and Sustainable Geotechnics methodologies, through the characterization and classification of ground masses and presentation of rehabilitation and stabilization solutions.

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