

## Final design for the securing of the rocky wall of Capo Vado (Savona – Italy)

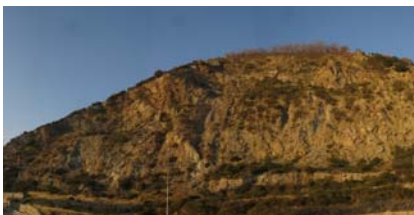
### General Data

- ✓ *Years: 2014-2015*
- ✓ *Customer: Grandi Lavori Fincosit S.p.A.*
- ✓ *Works value: € 1.135.000*

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View of the project area



Front view of the rocky wall



Works zoning

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### Characteristics of the works

Within the complex of works for the “New Multipurpose platform” of the Port of Vado Ligure, there is the realization of a concrete mixing plant slaved to the construction of the many artefacts in reinforced concrete. The area available for the construction of that facility was located at the access to the port from the S. S. Aurelia. Since the construction of the mixing plant and subsequent periods of operation require absolute safety for the workers and for the media operating around and within this, it is placed immediately the problem of mitigation risk of detachment and falling rocks from the rocky wall front of Capo Vado. This front is therefore the subject of accurate geological and geo-morphological analysis by climber geologists that have taken measures to achieve the drop tests and rolling boulders of sample in order to determine the possible trajectories in case of delamination, and the relative pulse forces in play. Based on these studies, it was decided therefore to identify a number of possible actions to mitigate the risks involved.

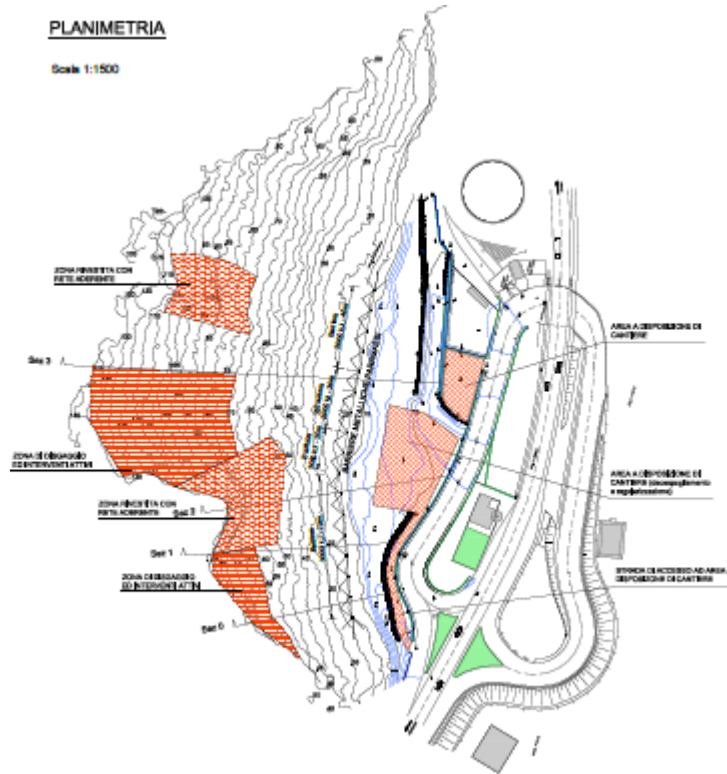
### “Passive type” solutions

They are represented by an array of rock-fall barriers with high deformability and thus high-energy dissipation. The elimination of the second alignment, placed at a greater height, imposed in the central portion of the front to foresee barrier modules with higher energy dissipation capacity (5000 KJ).

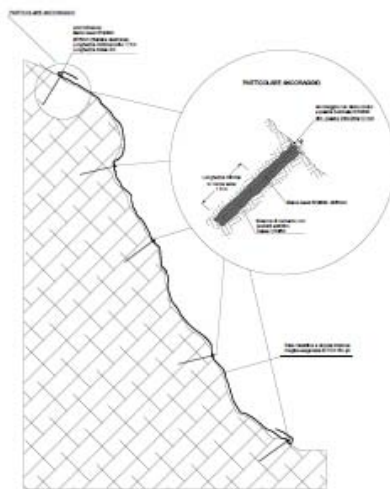
In the east section, the capacity is 3000 KJ; in the west section is 2000 KJ. The usable height of the barriers is constant and equal to 5 meters, while the planimetric arrangement runs approximately along the contour line of 20 meters above sea level. The barriers are anchored to the ground by bars and rods placed in the perforations in the solid rock, then stuck with tamping injections of the housing bore. The barriers will consist of metal uprights connected by steel cables which have also the function of supporting rope panels with high deformability. In correspondence with the terminals of the cables dampers for the dissipation of energy are foreseen. The barriers used will conform to UNI 11211 and ETAG 027 Standards.

### Blocks removal and “active type” interventions

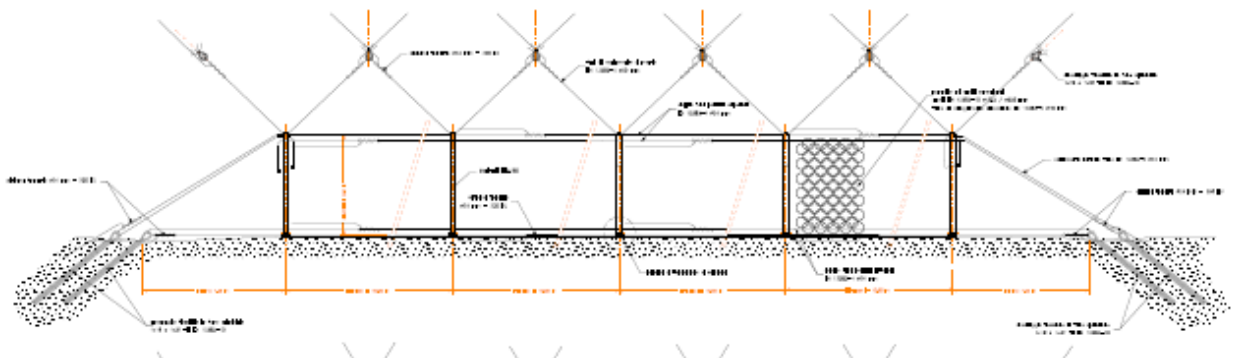
In order to limit possible future collapse of unstable blocks, two intervention methods can be used, each one complement to other: a) removal from the wall of the blocks in precarious balance conditions, by barring and stabilization of the same blocks through anchor and sewing techniques. The applicant methodology involves the use of end-anchored bolts, or the installation of injected guys that penetrate deeply into solid rock and stabilize blocks or unstable slabs. b) Positioning of armed adherents metal nets with rope panels. This technique has been provided in correspondence of zones with more marked steepness and in which you can predict the separation of minor size debris, but in greater quantity.



*Layout of the works on the rocky wall*



*“Active type” works (sewing)*



*Energy Absorbing Rock-fall Barrier*