

Article

A New Prototype for Automatic Identification of Stone Block Internal Structure

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Abstract: Nowadays, the inner shape and economic viability of a stone block is dependent on the skill and experience of the “expert” that makes predictions based on external observations. This actual procedure is an extremely high empirical method, and when it fails, substantial work, time, and money is wasted. At present, researchers are committed to developing models to predict the stone block internal structure based on non-destructive tests. Ultrasonic tomography and electrical resistivity tomography are the tests that best fit these objectives. Trying to improve the existing procedures for collecting stone information and data exporting, a novel approach to perform both tomographies is proposed in this paper. This novel approach presents sound advantages regarding the current manual procedure: namely, (i) high accuracy due to a new automatic positioning system; (ii) no need for highly skilled operators to process measurements; (iii) measurements are much easier to derive, and results are quickly delivered. A comparison between the new automatic process and the current manual procedure shows that the manual procedure has a very low accuracy when compared to the new developed automatic system. The automatic measurements show extremely significant time savings, which is a relevant issue for the future competitiveness of the stone sector.

Keywords: marble industry; PLC; mechanical design; automation; SCADA

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1. Introduction

1.1. The Marble Industry Context

Marble is highly used as a building material in construction due to its aesthetics, durability, and long-lasting characteristics [1–3]. Usually, marble slabs last as long as the buildings in which they were incorporated. This characteristic has motivated an increasingly high demand for this resource world-wide followed by a growing production quantity, reaching more than 150 million tons of ornamental natural rock in 2019 according to [4]. This means that the marble industry plays an important role in the economic structure of many countries. A considerable part of the quarrying and processing activities, in this industry, are performed worldwide by small and family-owned companies, which have a limited financial budget for investing in new techniques and machinery. This financial constraint leads to the use of less efficient methods, generating high production costs and significant waste of raw material. The most common method used to process marble goods starts with the quarrying of large marble blocks, which according to [5] are separated from the rock face by means of straddle bearing or explosions. Then, smaller portions are cut from the main block, using traditional cutting techniques, involving diamond wire saws that make linear cuts in the rock. The newly cut slices undergo a second stage of processing in which the blocks are