PIETRA SERENA MINING IN FIESOLE. PART III:
STRUCTURAL-MECHANICAL
CHARACTERIZATION AND MINING

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The large and deeply exploited quarry district of the Pietra Serena at Fiesole (Florence, Italy) was
worked out through centuries with no design or any preliminary investigation. In this paper, we
characterize the Macigno stratigraphic succession outcropping in the Fiesole hills in terms of geostructural
setting and geomechanical properties. We performed stability analysis to verify the safety of slopes of
open pits and underground openings, as well as retrospective review of the methods to provide safe
environment for Pietra Serena mining.

Quarry, dimension stone, mining, physicomechanical properties of rocks

PREFACE

This paper is the third of a series dedicated to the “Pietra Serena”, a traditional dimension stone
that was quarried since the Etruscan period to the middle of the 20th century in Fiesole, north of
Firenze, Italy.

The first part [1] envisaged the historical and cultural aspects, the second [2] the geological setting,
this one is devoted to the geostructural and geomechanical characterization of this old and tradition
type of quarrying activity. Next studies will regard the historical techniques of cultivation.

At the quarrying time no design, neither preliminary investigation were in use, throughout history
all this traditional and outstanding quarrying activity was designed in an intuitive way. But to-day, in
order to understand the “why” and “how” of the old quarrying techniques, we need to develop a
complete geostructural and geomechanical characterization of the Pietra Serena rock mass.

INTRODUCTION

The “Pietra Serena” is the dimension stones quarried from the best-grade arenaceous beds of the
Macigno, a quartz-feldspatic turbiditic sandstone, Oligocene-Early Miocene in age, largely outcropping
in the Fiesole area (Fig. 1). In the frame of 650 m of the outcropping sequence, only a few arenaceous
beds were cultivated as dimension stones (Pietra Serena) thanks to their thickness, strength, stiffness
and composition.

In the Fiesole hills the Macigno outcrops in a monocline setting dipping a few degrees (15–25°)
towards North, some transversal (SW-NE trending) faults cross-cut and differentially uplifted the
Macigno bodies (Fig. 2). Geostructural and geomechanical survey were performed according to the
recommendations [3–8].

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Fig. 1. Macigno succession outcropping in the Fiesole area. Lithotypes: 1 — coarse sandstones; 2 — thin bedded turbidites; 3 — marls; 4 — shales; 5 — calcarenites; 6 — quarried beds

**GEOSTRUCTURAL SETTING**

The Macigno succession can be subdivided into more alternating assemblage with different geostuctural and geomechanical characters, as referring to:

- **Type 1** are thin bedded, fine arenaceous turbidites (TBT), alternating with medium arenaceous beds (Ta-e, Tb-e) less than 1 m thick, rarely up to 2 m thick.

- **Type 2** are thin to coarse arenaceous turbidites in beds more than 1 m thick, often up to 3 m in thickness, with an interlayer of TBT.

- **Type 3** are medium to coarse arenaceous turbidites (Ta-e) in beds some meters thick; these are the quarried layers for ornamental purpose.

- **Type 4** are marls and shales, with rarely interlayered TBT and fine to medium arenaceous turbidites (Ta-d).

Pietra Serena come from the thick beds of the Type 3, but in order to follow both laterally and down-dip the cultivating beds it was necessary to uncover a large portion of the slope, usually constituted by the Type 2 and Type 3 (Fig. 3).

The Macigno body is affected by more main discontinuity system (Fig. 4). The subvertical ones are joints, which resemble slight variations in their trend in dependence with the diverse lithoacies types and bed thickness [9 – 15]. The gently dipping one is bedding.