

**From Art to Science of construction:
the permanence of proportional rules in the “strange case”
of the 19th century Ponte Taro bridge (Parma, Italy)**

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ABSTRACT

The Ponte Taro bridge, commissioned by Maria Luigia to Eng. Antonio Cocconcelli and built between 1816 and 1821 over the Taro River (near Parma, Northern Italy), is a very important monument, both from a cultural and strategic point of view. This 20 arches masonry bridge reaches the length of nearly 600 meters and constitutes a very interesting case study, not only for the technical and structural issues related to its restoration and use (with increased traffic loads) but also for the role that geometry played in its history and stability.

In this paper, a compared analysis on the historical ‘proportional theory’ and the constructive features of this ancient bridge is proposed. It is well known that ‘empiricism’ has been at the base of the main architectural constructions up to the 18th Century, but this geometrical method of structural design has been used, in particular for bridges, at least until the beginning of the 19th Century, despite the availability of the new theories of the newborn Building Science [1].

In the first part of the paper, the dimensional prescriptions for masonry bridges given by the most important treaties from XV to XVII century are presented and analysed, in order to compare them to those applied by Cocconcelli in the design of Ponte Taro [2], also discussing the changes in geometry that were introduced during the design phase. Hence, starting from the dimensional theory, a static analysis of the bridge is proposed by means of Mery’s graphic method, in order to investigate the structural safety level of the original project. Therefore, the results are checked by means of limit analysis, thus demonstrating the validity of ancient proportional theory for masonry structures.

Moreover, thanks to a high precision survey of the bridge (laser scanner and photogrammetric analysis carried out recently by Parma University), the realized structure has been compared to the original project by Cocconcelli, in order to detect, not only the historical transformations of the bridge during the construction phase, but also the deformation suffered by the structure in time (arches settlements, loss of symmetry, differential settlements of the piles), thus applying the “historical monitoring” procedure to the monument [3].

In conclusion, this work highlights the fundamental role of historical and structural analysis in considering the empirical calculation at the base of their original design. This procedure can help in investigating the real present structural behaviour of ancient masonry buildings and infrastructures, considering and reliably interpreting their present geometry in terms of constructive corrections or deformations occurred during time. The final aim of the work is to show the permanence of empirical analysis and proportional theory in defining reliable strategies of conservation for ancient masonry structures, thus confirming – even in structural analysis – the “Art of building” principles [4].

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