



## Thrust line analysis of historic bridges in Madrid Region

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## Summary

Historic bridges have been a matter of interest for many researchers and institutions, and are deeply studied from some points of view but seldom by structural analysis. Through the use of well-known simple but effective geometric principles we will present the analysis of a historic masonry bridges from the Madrid Region, as a methodology example. This structural information, besides the fact it has an interest of its own, can provide important guidelines for the conservation of historical heritage. As the structural behaviour of arches is related to geometry, the knowledge of maximum and minimum thrust is a powerful tool to check the stability of an arched structure through simple in situ measurements such as distance between imposts, rise or abutments dimensions. As a conclusion we will propose the inclusion of structural data in patrimony catalog in order to facilitate maintenance by supplying some guidelines about how surveys should be conducted in every case.

**Keywords:** historical bridges, heritage, conservation procedures, thrust analysis, maintenance, catalogue

## 1. Introduction

Bridges are structures that all along their lifetime will usually keep their original use. That means that there are prone to never (or seldom) be part of the intensive surveys and repairs related to the rehabilitation interventions very common in buildings.

Moreover, whenever a historical bridge becomes a source of interest, great attention is given to its component materials and general aesthetic shape. Repairs in the structure or foundations are implemented if any damage exists, but there is a general lack of knowledge about the structural behaviour of undamaged bridges. And, more important, there is no structural analysis that can foresee the collapse scenarios and the intermediate steps that could allow to detect if any catastrophic process has begun.

In the case of historic bridges in Madrid Region, some interesting research projects have been completed. From a descriptive information point of view, in 2009 the Department of Tourism of Madrid Region edited a tourist guide entitled “Historic Bridges in Madrid Region” [1]. This guide highlights the cultural heritage of Madrid Region bridges relating it to the public works policies that followed the designation of the City of Madrid as Capital in 1561, resulting in the appearance of new communications needs and routes, which until then had ran through more prominent cities such as Alcalá de Henares [2].

From the structural intervention point of view, the Regional Government Department of Patrimony has initiated in 2010 a program of rehabilitation of 110 historic bridges of the region, with the aim of not only keeping them in use but integrating them in touristic and free time activities.

As this programs supposes the investment of important economic and technical resources it is a great opportunity to increase the value of the intervention through the creation of a program of