

Elaboration of a rapid assessment method for masonry arches

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Abstract

Reassessment of masonry arches necessitates feasible methods for analysing the static behaviour of the persisting structure. In this paper, a method is presented that gives an approximation of the load bearing capacity using only very few geometrical dimensions. Unlike other commercial software kits, the methodology is not tailored to do an exact structural analysis using as-built drawings and documentations, but it is made for a rapid classification of civil engineering structures in the field. Characteristics of the proposed methodology are the analysis using thrust lines and the minimized time consumption for the exploration of the structural properties, which makes the approach the first choice for rapid classification tasks within the German Armed Forces. The application that will be delivered as an App for tablets and other mobile devices shall be used for rapid classification of masonry arches with regard to the crossing of military vehicles, but can easily be adapted for civil applications. For a worked example on the presented methodology, see [25].

Keywords: Masonry arch bridges, arch, reassessment, rapid classification, STANAG 2021, MEXE, BRASSCO-NG, line of resistance, coredimension, App, military technology, reconnaissance

1 Introduction

1.1 Historic Importance of Masonry Arches

Masonry arches can be traced back for 5,000 years, when chamber tombs were built, that resist their exposure to the forces of nature up to this day. In Roman times, the construction techniques were brought to perfection and prevailed in Europe up to the 20th century [1].

After first scientific theories by Poncelet [2] and Winkler [3], Jacques Heyman led the way to the modern analysis of arches by refining static methods and introducing plastic techniques in the 1960s [1].

Contributions by Moseley [5][6], Méry [7], Gerstner [8] and Rankine [9] led the way to the dimensioning

of masonry arches that pays respect to the special requirements of the material. Nowadays, Holzer introduced methods for a feasible re-evaluation of historic arches [10].

Even though analytical assessment methods can in most cases be done by hand calculation appropriately, form finding is still affected by tabled design values and rules of thumb that are depicted, e.g. in [11]. In a military context, simplified assessment methods such as the MEXE method were used to get a first glance at the load bearing capacity of an arch (see chapter 3.1). These empirical methods were completed by tabled results of Finite-Element-simulations, e.g. those conducted in [12] or [13].