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How to assess historic iron and steel bridges

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1 Abstract

The early industrialization process required a higher and higher developed infrastructure to transfer more and more people and goods. These requirements lead to the development of new materials that can resist the higher loading, to advances in mechanical engineering, more sophisticated calculation methods and transfer of all these advances to infrastructure to build longer spanning or higher rising structures. During the 18th and 19th century, the advances in industrialization resulted in new production processes, for iron, too. After using iron in mechanical engineering, it was applied to infrastructure as well [1]. Today, these first old iron and early mild steel structures belong to the cultural and technical heritage of the world. When looking at them as an assessing engineer, it is in favour understanding the production process, the resulting microstructure and the mechanical properties of the specific material. Any historic iron structure requires special knowledge about connections, structural design and of course, the material behaviour [2]. The paper presents these basics and some guiding documents on how to “engineer the past”. Selected representative heritage structures made of cast iron, wrought iron and early mild iron as well their material- and structure-specific requirements on rehabilitation are presented. Appropriate assessment procedures, developed e.g. in technical committees and European projects, allow us keeping the witnesses of the early industrialisation in service and the surviving structures being still in use. Finally, the background documents prepared in Europe will be shortly presented to guide the assessment of old iron bridges considering the past but in line with modern methodology. The background documents support the implementation, harmonization and further development of the Eurocodes for assessment, not only for design [3].

Keywords: Industrialization, historic iron, cast iron, puddle iron, early mild steel, microstructure, strength, rehabilitation, fatigue, assessment

2 Introduction

Understanding the characteristic properties of a material arising from the production processes of historic materials is a basic knowledge for the engineer assessing the safety of an old iron structure adequately. Understanding the existing structure is necessary to know the material precisely. The assessment consists of comparing today's loading, not neglecting the load history with the resistance of the old material. In case of higher loads to preserve an old bridge for future generations, appropriate rehabilitation measures must be chosen with respect to the old material.

Therefore, the first part of the paper is divided into historic material specific sections. From the material specific differences to modern structural steel it becomes clear, why assessment and rehabilitations measures vary between the three main types of historic iron, the cast iron, puddle (wrought) iron and early mild steel and -of course- modern structural steel. The second part of the paper presents some background documents for the assessment of old iron and steel structures, compiled in some European countries, European projects and technical committees to support the implementation, harmonization and further development of the Eurocodes.