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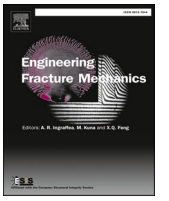

Residual life assessment of the historical road riveted bridges

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ABSTRACT

Numerous roads and railways network steel bridges exist with more than 100 years in service, often of great historical value. The in-service safety assessment of these structures is a complex problem which requires interdisciplinary approaches – from civil engineering application of Eurocodes or European recommendation for fatigue life estimation, up to an in-depth assessment by means of fracture mechanics. This article emphasizes the importance of rehabilitating the structure of existing steel bridges, considering the historical monument character of these structures, as well as the reuse of existing structures. Toward this aim, the study case for a historical riveted steel bridge build in the beginning of the twentieth century is presented, with an assessment method considering the structural integrity by means of fracture mechanics. Based on this case study, the paper is proposing an algorithm to assess historical steel bridges. The results of in-depth XFEM analysis with different crack size in the area of a riveted joint are also presented, in order to validate the algorithm.

1. Introduction

Establishing of the remaining life of old steel structures, is a matter of high importance if they are of a historical value. Also, when such an old steel structure is no longer able to fulfil the present needs, the re-use concept can give them a second life, if its safety and efficiency can be proved. This is a complex problem which requires interdisciplinary approaches – from civil engineering application of Eurocodes [1,2] or European recommendation for fatigue life estimation [3], up to an in-depth assessment by means of fracture mechanics.

Roads and railways network steel bridges with more than 100 years of service are numerous. To assess their integrity and remaining life, the first step can be to apply linear damage accumulation criteria, based on Miner rule, [4]. This can be followed by the use of fracture mechanics principles – the evaluation of the existing structures by means of engineering critical assessment (ECA) [5], as one of the available options within the scope of broader approach to structural integrity assessment, [6–10].

In the 90 s, Oehme [11] documented several cases of failure of some metallic structures. Fatigue failure ranked third after strength and stability failure in general, whereas in the case of bridges, the phenomenon of fatigue appears to be the leading cause of failure. All known collapses of steel bridges during service are analysed proving that approximately 38 % of about 130 of cases was caused by

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