Assessment methods for historical mild steel structures

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Summary

Although many structures made of mild steel erected during the period between 1890 and 1940 are still under load after decades of service, there is usually no need to replace them. When assessing these existing steel structures to be able to decide on necessary rehabilitation and reinforcement measures engineers requires information about the mechanical as well as the technological properties of the material. Additionally, it is essential to quantify the level of reliability against brittle failure. In contrast to conventional tests such as the impact test, fracture mechanics is suitable for appropriate assessment against brittle fracture of riveted or bolted structures made of old mild steel.

Keywords: mild steel; chemical analysis; material sampling; brittle fracture; embrittlement due to aging; weldability; notch impact test; fracture mechanics; J-integral

1. Introduction

During the fast development of new materials, methods of calculation and construction in the end of the 19th Century and the turn of the 20th Century many iron and steel structures were built, which are partly still in use today. Especially the old metallic materials and their characteristics are not familiar for many engineers being involved in the maintenance, repair and monitoring of existing buildings. A profound knowledge about old materials and their properties as well as about possible damages resulting from the use of structure is a basic requirement for a precise approach to the repair and maintenance of old steel structures.

2. Identification of old mild steels

The characteristics of the material used in old riveted structures are substantially different from those of modern steel. Recommendations e.g. in [1], list in detail the differences between the old metallic materials and provide information on possibilities to clearly identify the material (see Figure 1). The main structural materials of old steel structures are puddle iron and mild steel.

In the first step of the assessment of an old steel structure, it is recommended, to use information about the material from old design codes. Often the year of construction is known. If roll brandings specify information about the manufacturing steel rolling

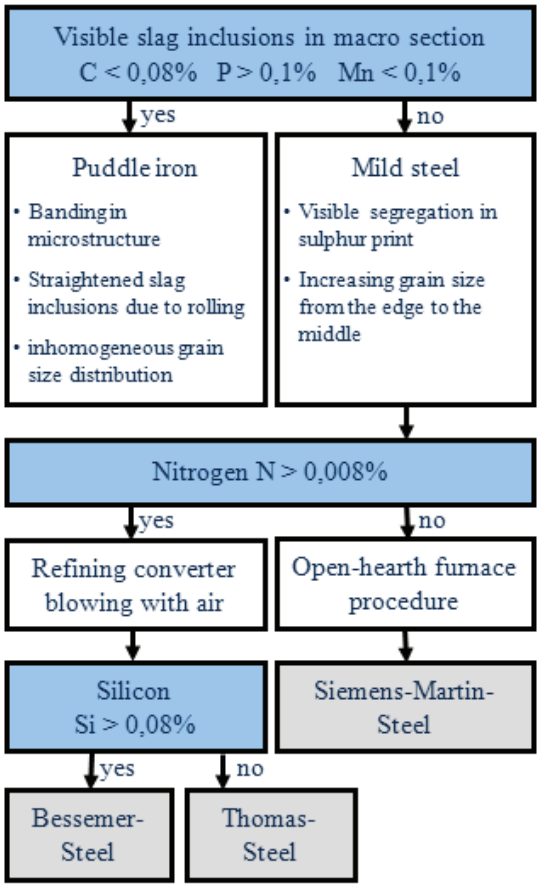

Figure 1: Classification of old steel [2]

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