

## 5 High-Performance Steels in Europe

### 5.1 Production Processes, Mechanical and Chemical Properties, Fabrication Properties

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#### 5.1.1 Introduction

Since the first application of steel in steel structures in the 19<sup>th</sup> century the development of steel construction has been closely linked to the development in material properties and production methods. Significant achievements concerning strength, economy, design versatility, fabrication and erection techniques and service performance would not have been possible without the substantial improvements of steel. Especially with the application of “new” production processes for carbon steels such as the thermo-mechanical rolling and the quenching and tempering process, steel with a high construction strength but guaranteeing also good fabrication properties such as weldability was introduced into the construction market. Today, the application of these grades is driven by the following major reasons:

- Economy: By increasing the strength of steel, the structural section can be reduced depending on the structural problem. This may reduce fabrication and erection costs – an important task in high-wage economies.
- Architecture: The size of structural elements can be reduced, enabling special aesthetic and elegant structures, which embed in the environment in an outstanding manner.
- Environment: Construction with less steel means also a reduced consumption of our world’s scarce resources.
- Safety: Modern high strength steel grades exhibit not only high strength values. Special grades combine this strength with excellent toughness so that a high safety both in fabrication and application of the structures is ensured. In particular, modern off-shore steel grades performing at some of the lowest service temperatures are a good example.

It should not be neglected that several other branches started with the application of high strength grades earlier. Mobile crane construction uses today steel grades up to a yield stress of 1100 MPa; in the offshore industry thermo-mechanically rolled steels in higher strength classes are likely to be the steel group the most often used for cold water applications. Even the shipbuilding industry has started to design with high strength steel. Nevertheless, this article focuses on the steel grades which are today used in steel construction (bridges, buildings, hydraulic steelwork) in Europe although we know that engineers in this field can profit a lot from the good experience made in other branches.