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The Art of Steel Structures

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Introduction

Iron has been used as construction material in human society for long time. The first iron- chain suspended bridge, 106 m span Jihong Bridge, was built in Southwest China in 1400s. In Europe, the first cast iron bridge appeared in 1700s in Telford, England. Cast iron was later replaced by more reliable wrought iron for construction of most railway bridges in early 1800s. It was not until late 1800s / early 1900s that steel structural systems appeared and took over iron in modern construction industry. Based on the manufacturing procedure, steel structures can be separated into two main categories: hot-rolled steel and cold-formed steel. Accordingly, there are two independent design and constructional systems.

After more than one century's development, steel has become the second widely used structural material after concrete in civil engineering industry. Because of its high strength- weight ratio, superior ductility and complete recyclability, steel has potential advantages in high-rise buildings, long-span structures, structures subject to heavy loadings or seismic loadings, and light-weighted structures.

Furthermore, owing to a large number of energy losses, global steel production's real resource efficiency is just 32.9 percent. With the increasingly increasing cost of primary oil, it is critical to increase energy efficiency in the iron and steel industry in order to minimise fossil fuel consumption and global CO2 emissions. To minimise the use of primary energy in steel plants, a variety of energy-saving technologies and steps are used.

In the iron and steel industry, these possible changes include composition management of incoming energy flows, modification of energy-related processes, and utilisation of outgoing flows. Various researches have partly achieved better energy consumption over the past decades, but the overall efficiency has not been significantly increased. Energy-saving technologies will continue to be relevant in the iron and steel industry in the future. These technologies should be tailored based on a mass network in order to reduce energy demands in the iron and steel industry.

Hook's law (1660), Euler's buckling formula (1757) and Timoshenko's plate buckling theory (1969) formed the fundament of steel design theory. Further studies were mainly focused on structural performance improvement and the determination of structural responses due to static loads, dynamic loads/actions and fire. Researches were carried out through experimental study, analytical/ numerical simulation, and field measurement.