

## The Main Directions taken by Road Bridges in the 20th Century

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### Abstract

By the end of the 20th century, road vehicles were transporting people and goods on an unprecedented scale. The success of individual motorised transport is closely linked with stages in the development of road bridges. Prior to the Second World War, four types of bridge indicated their potential by way of initial pilot projects. After 1950 they became the standard forms of construction within just 10 years and put their mark on urban and rural landscapes.

The article describes lines of development, key engineering personalities and the links between the different bridge types:

- prestressed concrete,
- steel-concrete composite,
- continuous steel cross-sections with directly trafficked orthotropic decks, and
- cable-stayed

together with their successes, focusing on German motorway bridges from the post-war years up to about 1965.

Using prestressed concrete for bridges has its roots in France and the acquisition of Eugene Freysinnet's (1879–1962) patent by German building contractor Wayss & Freytag, plus the theoretical principles behind creep and shrinkage researched by Franz Dischinger (1887–1953). A sideline points to Gustave Magnel (1889–1955), Oscar Farber (1886–1956) and the Swiss engineer Pierre Lardy (1903–58) [1]. Roughly at the same time, Swiss and American engineers used mechanical connectors to join together rigid reinforced concrete bridge decks and steel beams to form efficient composite superstructures [2].

The success of these new developments threw doubt on the economics of steel bridges. In an attempt to keep pace with the economic successes of concrete bridges, steel bridge engineers used their excellent theoretical knowledge of structural analysis and design to involve every component in carrying the loads.

The prestressing of cables and hence the knowledge gained from prestressed concrete bridges was the prerequisite for the building of modern cable-stayed bridges. The worldwide success of cable-stayed bridges began with the multi-cable patent of German engineer Hellmut Homberg (1909–90), whose final masterpiece, the QE II Bridge over the Thames (1991), was first opened to traffic after his death [3].

[1] *Pelke, E.*: Pre-Stressing of Bridges in Germany up to 1965 Part I and Part II. Proceedings of the Institution of Civil Engineers, Engineering History and Heritage 2011, 164 (2): 99-108 and 164 (4): 211-218

[2] *Pelke, E.; Kurrer K.-E.*: On the evolution of steel composite construction. Chicago: Proceedings of the Fifth International Congress on Construction History, June 3-7, 2015

[3] *Pelke, E.; Kurrer, K.-E.*: The Art of Major Bridge Building – Hellmut Homberg and his Contribution to Multi-Cable-Stayed Spans. Steel Construction 2012, Vol. 4, pp. 251-265