

## Assessing the durability and residual carrying capacity of a prestressed concrete footbridge built in Brussels (Belgium) in 1944

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## 1 Abstract

In October 1944, a 20.9m span footbridge was built in Brussels (Belgium) across the Canal Charleroi-Brussels: it was the first applications of prestressing by post-tensioning to a concrete bridge-type structure in Belgium, and one of the earliest worldwide. The tendons consisted of high strength steel wires 5mm in diameter anchored in so-called « Sandwich » anchorages, a system of post-tensioning developed in Belgium from 1942 onwards by Professor Gustave Magnel with the Blaton-Aubert Company. This system will be extensively used in Belgium during the next 20 years, and was also applied to build the first prestressed concrete bridge in the US in 1949 (Walnut Lane, Philadelphia). The dead weight of the footbridge is 60 tons. Some years ago, the local Authority had decided that this footbridge had to be replaced. This 1944 prestressed concrete footbridge was obviously an engineering heritage structure, but preserving it in use somewhere else raised many problems in terms of reliability. The authors therefore proposed to the Authority to study in depth this historical structure in order to collect information that could be useful to assess the durability and actual carrying capacity of concrete structures built with the same prestressing technology in the period 1945-1965, many of them still standing. The paper presents the main findings from the load testing of this footbridge, that took place in October 2018, and the results from the characterization of its materials.

**Keywords:** concrete structure, footbridge, prestressing, post-tensioning, Gustave Magnel, sandwich system, durability, load testing.

## 2 Introduction

Conventionally, prestressed concrete is considered to begin in 1928, when the French engineer Eugène Freyssinet filed his patent and began his experiments to develop the prestressed concrete technique. The first applications of these

techniques, in Algeria, France and Germany before the Second World War, remained very limited and experimental. By 1939, Freyssinet had succeeded in developing a post-tensioning prestressing technology based on the use of cables made of bundles of 12 high-strength steel wires with 5mm diameter with associated anchoring devices. But the outbreak of the Second World War would stop