



An innovative methodology to determine the partial load factor for prestressing in cable supported bridges

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Abstract

The design of cable supported bridges of short to medium spans requires the resolution of how to separate the load and effect of the major components of permanent loading: Gravity and Prestressing.

The Eurocode allows to use the same Ultimate Limit State factor for the Gravity “G” and the Prestressing “P” for flexible bridges and prescribes to use different factors for stiff bridges. However, there is no clear definition in the Eurocode of when a bridge can be considered flexible.

The paper introduces the concept of the Stay Force Response Index (SFRI) to define the degree of flexibility of the bridge and describes a method for the definition of the prestressing partial factor derived through a parametric analysis of concrete cable supported bridge.

This method, which is generally applicable beyond the Eurocode, would allow the designer to have the confidence in undertaking optimized hence, more economic and more sustainable designs.

Keywords: prestressing, cable supported bridges, flexible bridges, optimization, Construction Tolerance Parameter, Stay Force Response Index, Eurocode.

1 Introduction

Cable supported bridge systems in between the two classical bridge forms of beam-bridge and cable-stayed bridge have become common in short to medium span bridges in recent decades. Examples of these are extradosed bridges and stiff deck cable-stayed bridges.

The design of cable supported bridges requires the resolution of how to separate the load and effect of the major components of permanent loading: Gravity (G) and Prestressing (P).

The Eurocode [1], [2] allows the use of the same Ultimate Limit State (ULS) load factor for Gravity and Prestressing in flexible structures - $\gamma_G (G + P)$

combination- and the use of different partial load factors for stiff structures - $\gamma_G G + \gamma_P P$ combination.

This is because in flexible structures normal site monitoring of deflections and adjustments of cables guarantee there is no significant unintended imbalance between G and P. This means that they can be considered as a single permanent action and therefore be multiplied by the same ULS load factor

However, the Eurocode does not give further guidance as to how to differentiate between stiff and flexible structures. As a consequence so far, for structures such as extradosed bridges or “potentially” stiffer deck cable stayed bridges, the rule of stiff structure might have been conservatively used and this might have led to a