Advancements in shear strengthening of prestressed concrete I-girders using fiber reinforced polymers

Muhammad Arslan Yaqub and Stijn Matthys

Magnel-Vandepitte Laboratory, Department of Structural Engineering and Building Materials, Ghent University, Belgium

Christoph Czaderski

Empa, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland

Contact: MuhammadArslan.Yaqub@UGent.be

Abstract

A number of attempts were made by different researchers in the last couple of decades to strengthen prestressed concrete (PC) I-girders in shear using externally bonded FRP (fibre reinforced polymer) reinforcement. The unanimous observation reported in the literature is the early debonding of FRP shear reinforcement around the internal angles of the I-section. Because of this undesirable phenomenon, the strength of the FRP is utilized inefficiently. This paper gives an overview of the techniques utilized in the past and their relative performance in order to develop a rational solution to the debonding problem, particularly for I-sections. The anchoring techniques used in the past includes different types of FRP anchors as well as mechanical anchors to protect FRP shear reinforcement from debonding on the I-section. It can be concluded that the definite solution to the debonding problem on I-sections has not been obtained yet. This is because of the complex failure modes of FRP shear reinforcement and PC I-girders.

Keywords: Prestressed concrete I-girders; Shear strengthening; Fibre reinforced polymer; Debonding; Anchorage.

1 Introduction

With aging, the deterioration of all kind of structures including concrete bridges is inevitable. Prominent factors contributing to the degradation of concrete bridges include increased traffic volumes, impact damages from vehicles and poor design and detailing. Hence, the existing concrete bridge infrastructure demands repair and rehabilitation for its long run serviceability.

There are a lot of different methods available for repair and rehabilitation of concrete structures. However, the choice of a method involves several factors such as long run performance, cost effectiveness and service disruption during the process of rehabilitation. Considering all these factors, fibre reinforced polymers (FRP) qualify as one of the most suitable techniques for the repair and rehabilitation. FRP has been the subject of research in structural engineering for almost last three decades now. The obvious merits over the traditional strengthening materials include high

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