Use of fibre reinforced concrete for filler beam sections – potential for structural optimization

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Abstract

Fibre reinforced concrete (FRC) is a well-known solution for industrial floorings, tunnelling or specific other applications since decades and its use is extending towards a broader range of structures. It can act either as a complement to conventional bar reinforcement or, for specific cases, even as a substitute to it. Fibres are added to concrete firstly to enhance its tensile behaviour but can bring other substantial benefits. In particular, high-strength steel fibres have a considerable impact even when added in moderate quantities to the concrete mix, therefor with reduced additional cost.

This paper will investigate the potential of steel fibre reinforced concrete in the field of steel-concrete composite structure, a combination which is still vastly unexplored. The case of encased composite bridge sections (filler beam decks according to Eurocode 4) will be analysed by numerical simulations. The results show benefits in term of ultimate limit state, serviceability limit state as well as durability. This preliminary study serves as guidance for future experimental campaign.

Keywords: filler beam bridges, fibre reinforced concrete, high-strength steel fibres.

1 Introduction

Fibre reinforced concrete (FRC) is established as the solution of choice in several industrial or tunnelling applications. The trend is towards an increased use in structural applications [10], where it can play a significant role both at serviceability limit state (e.g. increasing concrete tensile properties permit to decrease crack formation and width) as well as ultimate limit state (e.g. for flat slabs they can be a substitute of traditional reinforcement). They may bring also other important benefits (e.g. reduced concrete spalling in case of fire exposure).

Fibre reinforcement may be realized out of a variety of materials. Amongst them steel fibres is the solution of choice for standard structural applications thanks to their high strength (commonly available products over 1500 MPa yield strength) and moderate unitary cost.

The structural behaviour of fibre reinforced concrete has been intensively researched over the last decades and the knowledge is now mature enough to be transferred in codes (e.g. [5]). In this sense it can be expected that practitioners will increasingly use this product in the future.

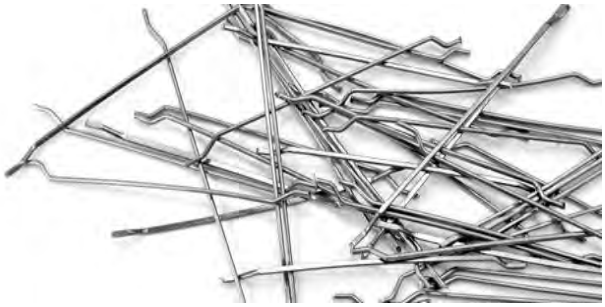

Figure 1. View of hooked-end steel fibers [20]