Steel Fibre Reinforced Concrete for Sustainable Construction

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Abstract

Steel Fibre Reinforced Concrete (SFRC) has gained significant popularity in the construction industry due to its enhanced mechanical properties and cost-effectiveness compared to traditional reinforced concrete. The use of SFRC has increased in recent years in various applications, such as industrial floors, tunnel lining segments, precast elements, and special load bearing structures such as foundation rafts on ground or on piles. The aim of this paper is to provide an overview of SFRC in today's Finnish construction industry, highlighting its benefits but also the challenges. This paper also deals with the sustainability of material, with the efforts that are being made to introduce green steel fibres made with recycled material and their production from green source of energy, which in the end will have less embodied carbon footprint.

Keywords: SFRC; steel fibres; green steel fibres; recycled steel fibres; GWP; sustainability

1 Introduction

1.1 Context

Our planet faces multiple environmental challenges and one of this is certainly excessive use of natural resources threating the sustainable development [1]. Use of material such as steel (7...9 % of total global CO_2) and concrete (7 % of total global CO_2) are big part of CO_2 emissions [2]. To reduce the amount of steel material and to use if even more effectively alternatives to conventional reinforced concrete the steel fibre reinforced concrete (SFRC) has been extensively studied in recent years, and numerous research works have been carried out to investigate its mechanical properties, durability, and behaviour under different loading conditions. This literature review provides an overview of the research works related to SFRC in today's construction industry, highlighting its benefits, challenges, and prospects.

To give a concrete example of material reduction, let's take an example of 3 m deep 500 mm thick raft on piles under the road carrying a pipeline is subjected to approximately 150 kPa of vertical ULS distributed load. The amount of steel necessary to satisfy all the design requirements, we typically need around 125...150 kg/m^3 of conventional rebar steel. The same structure under similar loading conditions can be carefully designed with couple of more piles and by keeping the same raft thickness, and with a dosage rate of end-hooked high-performance steel fibres of range 40...55

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