UHPFRC is ready to revolutionize existing and new structures

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Abstract

"Structural UHPFRC" stands for Ultra-High-Performance Fibre Reinforced Cementitious Composite material which is complemented by reinforcing and prestressing steel to enhance the resistance and durability of structural elements. Properties of impermeable, tensile strain hardening UHPFRC are discussed in view of structural applications. Two fundamental concepts to enhance concrete bridges have been developed by research and validated by numerous applications, mostly in Switzerland: 1) Rehabilitation and strengthening of existing concrete structures by adding a layer of structural UHPFRC, and 2) Construction of new structures in Structural UHPFRC, often composed of precast elements. These applications show that "Structural UHPFRC" has made its proof as a novel building material and technology to enhance bridges and structures in general. UHPFRC also contributes in lowering the environmental impact of structures and thus improving sustainability. UHPFRC is at the beginning of a new construction era: the "post-concrete era".

Keywords: UHPFRC, tensile properties of UHPFRC, rehabilitation and strengthening of reinforced concrete using UHPFRC, design of UHPFRC structural elements.

1 Introduction

"UHPFRC" stands for Ultra-High-Performance Fibre Reinforced Cementitious Composite materials. UHPFRC is composed of cement and other reactive powders, additions, hard fine particles, low amount of water, admixtures and very high amount of relatively short and slender steel fibres.

UHPFRC materials have been developed over the last 40 years. The pioneering development has been conducted by Hans-Henrik Bache in Denmark. Today, the best UHPFRCs have significant tensile strain hardening behaviour and high strength both in tension and compression. To enhance the structural behaviour and resistance, it is advantageous to complement UHPFRC with reinforcing bars and prestressing. UHPFRC is a dense material of optimized compactness and is thus waterproof and crack-free under service stresses, thus providing robust protection against water and chloride ion ingress.

UHPFRC does not comply with the definition of "concrete", and therefore, UHPFRC should not be called "concrete" as is evidenced in Figure 1.

Figure 1. UHPFRC–concrete core showing the obvious difference between the two materials.