

Macro Synthetic Fibre Reinforced Concrete

Market Update - September 2021



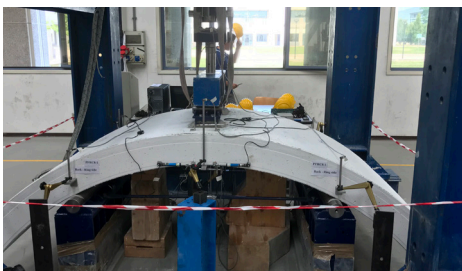
Macro synthetic fibre concrete reinforcement.



MSFR Shotcrete Ground Support.



Prestressed grandstand elements.



Full scale segment testing Universtiy of Brescia.

Macro Synthetic Fibre Reinforced Concrete (MSFRC) is an innovative construction material which was first used commercially in the 1990s. MSFRC was initially adopted in shotcrete for temporary ground support, as well as in flooring and pavement applications. MSF provides similar or superior toughness performance compared to steel alternatives but is a non-corrosive material, a property that drove initial growth. In the last decade, new guidelines, standards and practices have seen the structural use of MSFRC increasing, especially in precast concrete and in cast-in-place applications.

While the design of shotcrete and flooring applications is covered by specific guidelines, structural elements must be designed in accordance with structural codes such as the Model Code 2010 [1]. In Italy and Spain, for instance, the design of FRC structures (both steel and MSF) is covered by the national codes CNR-DT 204 [2] and the EHE-08 [3], respectively. The normative regulation of fibres is allowing engineers to design FRC elements in a regulated and harmonized manner and to expand the use of fibres as an alternative to traditional steel bars. The same approach is followed in the USA by ACI PRC-544.4R-18 [4], thereby guaranteeing a coexistence of both types of fibres while promoting a natural competitiveness which, in practice, leads to research, development, and higher added value for end users and clients.

In the last five years a significant amount of research has been carried out by leading institutions including the University of Brescia [5], Polytechnic University of Catalonia [6], KU Leuven [7], University of Texas [8], EMPA Zurich [9], Polytechnic University of Valencia [10], and RILEM TC 261 CCF [11]. Moreover, a state-of-the-art report detailing the main features of the various research programs was recently published by Tošić et al [12].

The MSF market growth rate has been conservatively estimated at above 10%

per annum over the last five years [13], driven largely by increases in structural applications of MSFRC along with continued adoption of known applications in new markets. The 2020 market value in Europe was estimated to exceed EUR 100 million and is projected to be more than EUR 200 million by 2030.

More recently it has been shown that MSF can contribute towards sustainability in concrete construction. Research, along with modelling through Environmental Product Declarations (EPD's) have demonstrated that significant reductions in carbon footprint can be achieved when compared to steel reinforcements [14, 15, 16]. In addition, handling of concrete elements with MSFRC has been quantified and proven to be safer [16] and, for a wide range of elements, the overall reinforcing costs can be considerably reduced [17].

The market share of precast FRC tunnel segments compared to traditionally reinforced segments continuously grows. Recent publications such as the ITA WG2 Report [18], the ITAtech guideline No.7 [19], the British PAS 8810 [20], the fib state-of-the-art report [21], and the ACI Report PRC-544.7-16 [22] have given more credibility to the use of this reinforcement type as well as its basis for design to support its application in tunnel lining segments.

The use of MSF in tunnel segments is increasing globally. MSF are non-corrosive and thus ideal for segmental linings in critical environments where steel fibre and rebar cages require additional durability controls. A major reference for the use of MSF as sole structural reinforcement for precast tunnel segments is the Santoña-Laredo General Interceptor Collector in Northern Spain [17]. This project demonstrated very robust and dependable performance of the MSF reinforced segments even under most difficult conditions [23].

The first use of a macro synthetic fibre reinforced segmental lining in North

America was installed in the Blacksnake Creek CSO tunnel in St Joseph, Missouri [24]. Technical challenges comprised an umbilical TBM launch in a shaft of limited size and significant TBM steering complications at various times, leading to sizable eccentric forces acting on the segmental lining. The project was both a technical and commercial success.

Permanent shotcrete lining projects in Norway, Japan, the UK, Canada, and Australia demonstrate additional structural applications of MSF in tunnelling, with the North Strathfield rail underpass near Sydney, Australia, being an outstanding example for a challenging project that is sensitive to deflections and ground subsidence while being constructed under live rail traffic [25].



North Strathfield Rail Underpass.

Representing an outstanding civil project is the Debrecen Stadium in Hungary using MSF as the sole shear reinforcement in the prestressed grandstand elements [26].

To create a united voice for the industry, leading manufacturers of MSF have established an association dedicated to the development of MSF and its application fields [27]. The Macro Synthetic Fibre Association (MSFA) is based in Switzerland and by today comprises eleven member companies [28]. The aim of the MSFA is to provide confidence and support to users by education and training, as well as resolving the various technical issues still seen as barriers to entry for this product. The MSFA represents the interest of members on national and international professional bodies, within standard and code committees, and in educational establishments around the world. In this regard the MSFA cooperates closely with the Fibre Reinforced Concrete Association (FRCA), based in the USA [29].

To provide an accurate and unbiased comparison of the performance and benefits of steel fibre-reinforced concrete (SFRC) and macro synthetic fibre reinforced concrete (MSFRC) a Position Paper has been developed jointly by the MSFA and the FRCA [30]. Further Technical Notes are in progress.

Please meet our member companies on BEFIB 2021 in Valencia to get more information on the MSFA, our activities or how to become a member.

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The Macro Synthetic Fibre Association

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The Macro Synthetic Fibre Association (MSFA) is committed to the development of international standards and guidelines for the use of macro synthetic fibre concrete reinforcement. The MSFA is the leading authority on the safe use and development of macro synthetic fibre concrete reinforcement in international markets.

This information has been provided as a guide only. The user is advised to undertake their own evaluation of specific requirements for any project or application. Edition 1 © MSFA 2020.