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# Simplifying the manufacture of precast elements

**Thanks to technological progress, structural steel fibre reinforcement today offers a number of advantages and has been successfully employed for over 25 years in the manufacture of precast elements and flooring. This article describes the different types of fibres available on the market and the various applications of these fibres. Furthermore, the article highlights the ways in which the use of fibres can simplify the production of precast concrete elements.**

## Fibre categories

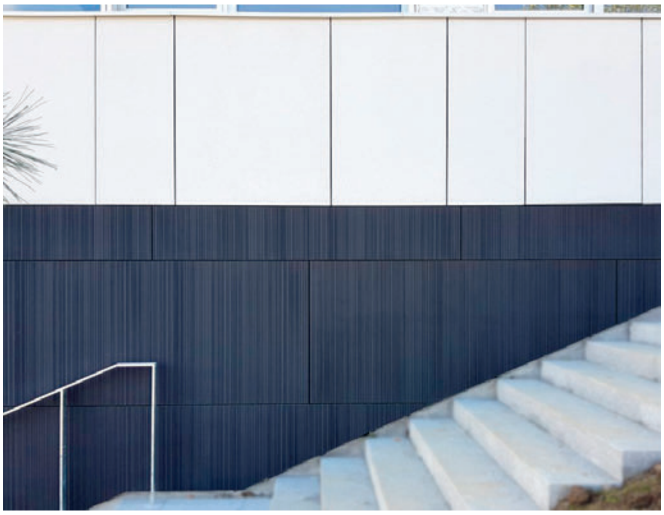
In the construction sector, one will essentially encounter three types of fibres for a wide range of applications and requirements:

- Glass fibres offer relatively high strengths, but have the disadvantage of being expensive and brittle.
- Plastic fibres are used for two main applications: to counteract the phenomenon of shrinkage, and, in the case of micro-synthetic fibres, to increase concrete fire resistance.
- Steel fibres are the only ones generally recognized to exhibit structural properties [1]
- Steel fibres come along in the most different shapes; the two shapes most commonly used being:
- Straight fibres (relatively thin, i. e., less than 0.3 mm in diameter)
- Cranked fibres equipped with hooks of variable shapes at their ends, with lengths ranging from 30 to 60 mm and diameters between 0.5 and 1.1 mm.

Depending on fibre geometry, there can be between 100,000 and even 40 million fibres embedded in 1 m$^3$ of concrete, which would translate into 6 to 480 km of wire; the main objective being the prevention of crack formation.

*Dramix steel fibres in fresh concrete*

*Isla de Arosa: 7,500 m² white non-structural skin, thickness: 10-20 mm*



*German College of Bilbao: 1,100 m² textured skin and 1,100 m² pure white panelling, thickness: 14-16mm*

## Steel fibre applications

Dramix Steel fibres essentially serve the same structural functions as rebar, but boast a tensile strength 2 to 4 times higher than the latter because of rolled steel, and are today found in a wide variety of applications.

This can largely be explained by their ease of implementation, which makes these fibres become an alternative in cases of construction elements with reduced thicknesses, complex geometries, or when homogeneous reinforcement is required.

Historically, the first applications of steel fibre reinforced concrete (SFRC) were in the area of industrial flooring, but meanwhile, SFRC has also been used for many years in:

- Drill & blast tunnelling operations
- Segmental linings for tunnelling operations by means of boring machines
- Concrete sewer pipes, manholes
- Water tanks, wastewater tanks
- Substations and telecom rooms
- Basement walls and balconies
- Staircases and street furniture
- Architectural UHFRC
- Off-site construction

## SFRC fibres in concrete

The concrete-metal pair of materials has been known and tested for decades. Steel fibres are the only construction material that is insensitive to hygrometric variations (if galvanized, it is even popular when it comes to maritime applications). Steel fibres do not generally creep over time, only in the event of major temperature changes, minimal shrinkage deformation will occur. Since the fibres are added to the concrete during the mixing process, their addition cannot be forgotten on the job site or incorrectly introduced the way this may happen when rebar or reinforcing cages are used. Also, the fibres are evenly distributed in the concrete, including in the so-called coating area, which is only relevant anyway when rebar is used at the same time.

On account of isotropic fibre dispersion, enormous advantages over conventional material designs can be achieved.

## Benefits of SFRC

When designing the concrete, no special precautions need to be taken. A calculation carried out on the basis of Model Code 2010 (validated by scientists all over the world since 2010) will suffice and is both simple and flexible. If necessary, calculations can readily be based on finite element modelling.

The implementation of Dramix fibre concrete does not present any difficulty whatsoever. However, heightened vigilance is required when moulds display a certain degree of surface roughness or if elements are used with cross-sections of similar sizes as those of the fibres used.

Precasters using Dramix fibres in their facilities will always attempt to ensure a 100% fibre solution without any rebar or mesh. On the other hand, a combination of both reinforcement procedures can very well be chosen to arrive at optimal load resistance values.

## Almost no production tool adaptation

A modification of the precaster's concrete recipe when changing to SFRC is only necessary in exceptional cases. Dramix steel fibres are introduced into the production process as soon as possible, either via skip or weighing belt. For this


*Greyshield – patented and optimized method to attain shielded rooms*

purpose, a dosing unit capable of receiving 1.1 tons of fibres for automatic dosage to the nearest 100 g for about 40 m³ of concrete is recommended.

This flexibility allows precasters to diversify their production and to develop new applications for accessing new markets.

## Further innovations

Since there is no need for concrete coatings when using Dramix fibres, reduced concrete structure thicknesses are possible. The unique skins of sandwich panels, for example, can be executed in SFRC with thicknesses ranging from 1.0 to 2.5 cm at very high impact resistances.

These elements can also be used as "lost" moulds, with infinite options in terms of coloration and shape.

Another advantage of SFRC is its ability to partially attenuate the electromagnetic waves frequently used by human beings, namely 100-6,000 MHz.

A patented multi-purpose element containing Dramix fibres will allow for - depending on wall thickness, fibre type used and dosage – a Electro Magnetic Mitigation (EMM) of up to 100 dB (see Greyshield).

Therefore, this component, structural by its very nature, has a special EMM function, which permits the construction of shielded rooms at only about half the cost, i. e., data centres, rooms for sensitive company data, or protection against potentially harmful 5G waves.

As part of a partnership, an innovative French company is relying on Dramix fibres in high dosages (up to 100 kg/m³) to manufacture C70 or C100 concrete in its own mix.
The properties of this new concrete, produced at an acceptable price, have led to the development of the Cubik Home Concept which allows all precast facilities featuring production tables (fixed or as a carousel system) to become a manufacturer of these types of customized housing modules.

This off-site construction process drastically reduces construction time, cost and environmental impact.


*Positioning a modular Cubik Home with Dramix fibre reinforced concrete at its final location*


*Setting up a 3-module model home in only 6 hours*

After concreting, the walls with thicknesses of 7 and 5 cm are assembled to form 3D modules that have been pre-equipped in the manufacturer's factory before delivery. This makes it possible to provide customers with high-quality and high-performance turnkey housing in record time.

Thanks to the concrete recipe used and the 12 cm insulating layer already integrated during manufacture, the output modules offer excellent thermal resistance. In addition, these modules provide high resistance to earthquakes up to Level 8 on the Richter scale and to hurricane impacts of Category 4. ■

[1] fib Model Code 2010: Bulletin Nr. 55, veröffentlicht von FIB (Oktober 2010) Kapitel 5.6 www.fib-international.org/publications/model-codes.html

**FURTHER INFORMATION**

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