Introduction

Modern day distribution centres and warehouses have become very sophisticated. Clients are demanding very high performing floors.
This is mainly due to higher racking systems and the increased speed of the material handling equipment. Every industrial floor has its own individual specific needs and getting the design and detailing right is not simple or straight forward.

At **CANZAC** we understand the lower lifetime cost of an industrial concrete slab on grade and we most certainly deliver the best lifetime value.
Our engineered product offering is second to none. We have a wealth of knowledge when it comes to design input. We simply know what works and what does not work. When you consider the up-front cost of the concrete slab is about 13% of the total project value.
All too often during the design and construction process, the owners or occupiers are not aware of the issues they will be dealing with in 18-24 months' time or the associated costs and down time that has to be paid for to repair badly designed and constructed concrete floors.

Many industry designers, owners, and occupiers of CANZAC slabs understand our true value, lowest maintenance costs, better material handling speeds and earlier project delivery.

Our well designed detailed and constructed steel fibre floors are becoming very popular. This is due to our engineering and design expertise.
Our understanding of critical control joint detailing for construction/contraction /isolation and expansion joints. Along with reinforcing detailing dowel type and spacing via our in-house load transfer programme.

As a rule of thumb, small fibres tend to be used where control of crack propagation is the most important design consideration. High fibre count (number of fibres per kg) permits finer distribution of steel fibre reinforcement throughout the matrix – and, consequently, greater crack control during the drying and curing process. On the other hand, because they exhibit better matrix anchorage at high deformations and large crack widths, longer, heavily deformed fibres afford better post-crack 'strength'. However, unlike shorter fibres, the dramatically reduced fibre count of longer product yields correspondingly less control of initial crack propagation.

Conventional practice usually concentrates welded wire fabric reinforcement within a single place of a floor slab.

Introduction

Fabric does very little to reinforce the outer zones, which is why spalling is common at the joints and edges. The primary function of welded wire fabric is to hold the floor slab together after the first small hairline cracks have propagated to larger fractures. This serves to maintain some degree of “structural integrity.”

Conventional wisdom’s approach to floor slabs is to maintain “material integrity” through SFRC mix designs.

This “integrity is accomplished” by:

- Increasing the initial first crack strength.
- Large numbers of fibres intercepting the micro-cracks through-out the slab to reinforce isotopically, so there is no weak plane for a crack to follow.
- Unlike rebar and welded wire fabric, fires are dispersed throughout the slab to reinforce isotopically, so there is no weak plane for a crack to flow.
- Increases in flexural strength can make it possible to use a thinner slab and eliminate the cumbersome welded wire fabric.
- Whether it is for lighter duty commercial service or for heavy manufacturing, SFRC slabs are capable of withstanding any load. The only variable is the addition rate of fibre, which could be as low as 12.5kg/m3 to as high as 100 kg/m3.

Durability

The corrosion resistance of Fibercon fibres is governed by the same factors that influence corrosion resistance of conventionally reinforced concrete.

As long as the matrix maintains its alkalinity and remains uncracked, deterioration is not likely to occur. There is a specific advantage of Fibercon fibres over fabric or bar reinforcing insevere exposure environments. This is that the fibres, being unique and discrete, will not support classic galvanic corrosion cells, which are often the cause of corrosion and deterioration in fabric and bars. Hence Fibercon fibres can be used to advantage in extremely aggresive environments.

Impact Strength

The drop weight test used in an investigation is not a truly scentific test as it does not give accurate quantitave values for impact resistance. However, this is a very simple test that can give a comparative example of the performance in concrete. The impact strength increases considereably with the increase in fibre content. Compared to plain concrete, the increase in impact strengths were significant, a 12kg per cubic metre increased the impact strength 10 fold. The results prove that the addition of Fibercon fibres significantly increase impact resistance.

Punch & Shear

Fibercon high strength steel fibres have the ability, even at moderate addition levels, to improve punch and shear.
Tests have been done to compare punch and shear behaviour of:

- Plain Concrete
- Concrete reinforced with 2 layers of welded wire fabric
- Polypropylene Fibres
- Mill cut steel fibres
- High tensile deformed steel fibres

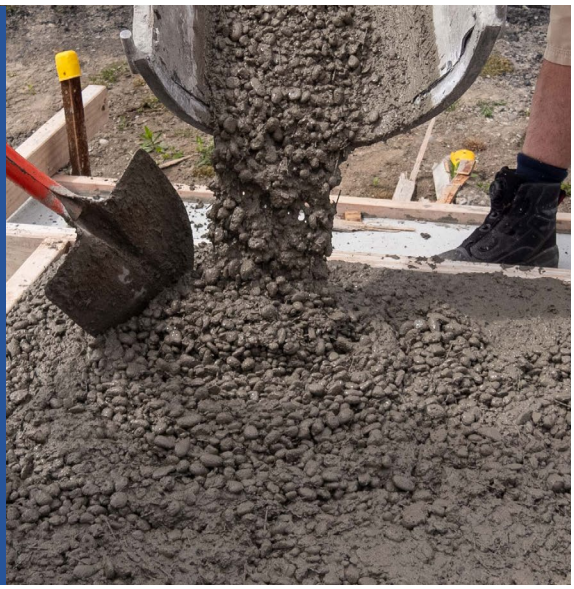
It was observed that the values of punch and shear are improved by the addition of relatively small quantities of steel fibres.
No punching was observed.

Advantages

Reinforcing concrete with steel fibres results in durable concrete with a high flexural and fatigue flexural strength, improved abrasion, spalling and impact resistance.

The elimination of conventional reinforcement, and in some cases the reduction in section thickness can contribute to some significant productivity improvements.

Steel fibres can deliver significant cost savings, together with reduced material volume more rapid construction and reduced labour costs.



The random distribution of steel fibres in concrete ensures that crack free stress accommodation occurs throughout the concrete.
Thus, micro cracks are intercepted before they develop and impair the performance of the concrete.

Improved Strength & Durability

Steel fibre reinforced concrete is a castable or sprayable composite material of hydraulic cements, fine, or fine and coarse aggregates with discrete steel fibres of rectangular cross section randomly dispersed through the matrix.

Steel fibres strengthen concrete by resisting tensile cracking. Fibre reinforced concrete has higher flexural strength than that of unreinforced concrete and concrete reinforced with welded wire fabric. But unlike conventional reinforcement – which strengths in one or possibly two directions – Steel fibres reinforce so tropically, greatly improving the concrete's resistance to cracking, fragmentation spalling and fatigue.

When an unreinforced concrete beam is stressed by bending, its deflection increases in proportion with the load to a point at which failure occurs and the beam breaks apart.

A steel fibre reinforced beam will sustain a greater load before the first crack occurs. It will also undergo considerably more deflection before the beam breaks apart. The increased deflection represents the toughness imparted by fibre reinforcement.

The load at which the first crack occurs is called the 'first crack strength'. The first crack-strength isgenerally proportional to the amount fibre in the mix and the concrete mix design.

Two theories have been proposed to explain the strengthening mechanism:

The first proposed that as the spacing between individual fibres become closer, the fibres are better able to arrest the propagation of micro cracks in the matrix.

The second theory holds that the strengthening mechanism of fibre reinforcement relates to the bond between the fibres and the cement. It has been shown that micro cracking of the cement matrix occurs at very small loads. Steel fibres then serve as small reinforcing bars extending across the cracks. So as long as the bond between the fibres and cement matrix remains intact, the steel fibres can carry the tensile load.

The surface area of the fibre is also a factor in bond strength. Bond strength can also be enhanced with the use of deformed fibres, which are available in a variety of sizes.

Technical Information

Fibercon Steel Fibres

The principal of all Fibercon steel fibre reinforced concrete is to provide discrete, discontinuous reinforcement and effective crack control.

Fibercon Steel Fibres are available in various shapes and sizes to suit different applications.

Fibercon works becuase unlike mesh reinforcing, the steel fibres reinforce in three dimensions throughout the entire concrete matrix.

The fibre functions to reinforce and restrain micro-cracking, essentially acting as“miniature reinforcing bars”. Thus the earlier the crack is intercepted and its growth inhibited, the lower the chance of it developing into a major crack.

The fibres are made from Hard-Drawn low-carbon high tensile steel wire, and are Continuously Deformed conforming to the provisions of ASTM 820 Type 1.

Properties of Reinforcement

When steel fibres are added to mortar, Portland cement concrete or refractory concrete, the flexural strength of the composite is increased from 25% up to 80% - depending on the proportion of fibres added and the mix design. Steel fibre technology actually transforms a brittle material into a more ductile one. Catastrophic failure of concrete is virtually eliminated because the fibres continue supporting the load after cracking occurs. And while measured rates of improvement vary.

Steel fibre reinforced concrete exhibits higher post crack flexural strength, better crack resistance, improved fatigue strength, higher resistance to spalling, and higher first crack strength.

Additionally, deformed fibres provide a positive mechanical bond within the concrete matrix to resist pull-out.

Features

& Technical Specifications

- Provides good impact, fatigue and shrinkage control in all grade concrete
- Easy to use at high doses in high performance pavements
- Is suited for hand and laser screeding and conventional finishing
- Is very good in post crack control (toughness)
- It's positive mechanical anchorage gives exceptional 3 dimensional post-crack control
- Performs and sprays well in concrete applications
- Very economical

FIBRE	General Purpose Fibre
MINIMUM TENSILE STRENGTH	800MPa
FIBRE STRENGTH	38mm
TOLERANCES	+ or - 5%
DESCRIPTION	Semi circular in cross section
ANCHORAGE	Continuous deformation
APPEARANCE	Bright and clean wire
COMPLYING	ASTM A820 Type 1 & AS1379-1991

Product Mix Designs

The proportions of Steel fibres in mix designs usually range from 0.2% to 2.0% (15 to 40 kg / m3) of the composite's volume. Key factors to consider largely depend on the application under consideration and or the physical properties desired in the finished project.

Mix designs with fibre proportions above 40 kg/m3 are usually adjusted to accommodate the presence of millions of steel fibre reinforcing elements. The adjustments are an increase in the cement factor, a reduction in the top size of the coarse aggregate and the addition of a super plasticiser. Prototype testing is recommended to determine the optimum design for each application.

Applications of use

Industrial Ground Floor Slabs – Warehouse, Factories, Distribution facilities, Container hardstand areas, Aircraft Hangers, Roads, Bridge Decks, Parking Areas, Runways, Aprons and Taxiways, Commercial and Residential Slabs.

Slabs

- Eliminates Steel Mesh Reinforcement: Saving both materials and labour on site
- Increase speed of production on site
- Save time and reduce costs
- Have stronger and simpler joints
- Reduce spalling and maintenance with the high impact resistance
- Ideal for Large Areas
- Ideal for High Load or High Impact Application
- Has been used for the last 15 years in industrial and Commercial applications with many millions of sqaure metres succesfully placed

Precast

- Eliminates Steel Mesh Reinforcement
- Dramatically increases production
- Reduce labour and reduce skilled needs
- Reinforces the edges and corners of precast products
- Reduced product damage and wastage as the fibres distribute completely through the concrete
- Fibrecon is approved for use under AS/NZ 1546.1:1998 Onsite Domestic Waste Water Treatment Units. Many manufacturers are using the fibrecon system. The Code allows for a reduction in concrete thickness with Fibrecon Steel Fibre System. Over 10,000 systems have been manufactured
- Can be used in Water Tanks, Pits, Head Walls, Risers, Troughs
- Fibrecon offers full engineering support if required

Shotcrete

- Increase safety by not having to replace reinforcing in difficult situations
- Save time and money on site by eliminating mesh
- Homogenous reinforcement to resist tensile forces in any point in the shotcrete layer
- Excellent corrosion resistance, no electrolytic corrosion in the shotcrete
- Minimisation of losses due to rebound and no loss of integrity due to shadowing from mesh
- Reduced material use as a thin layer of Steel Fibre reinforced Shotcrete can follow uneven contours with the need to achieve reinforcement cover
- Ideal for Mining and Tunnel applications, slope stabilisation, soil nailing, embankments, erosion control

Summary

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Fibercon Steel Fibres improve the properties of concrete in many ways and is summarised below.

PHYSICAL PROPERTY	BENEFICIAL EFFECT
Modulus of Rupture Concrete	1 to 2 x plain
Shear Strength Concrete	1.25 to 2 x plain
Torsional Strength Concrete	1.25 to 2 x plain
Impact Energy Absorption Concrete	2 to 15 x plain
Fatigue Resistant Concrete	1.2 to 2 x plain
Cavitation and Erosion Resistant Concrete	1 to 1.4 x plain
Restrained Skrinkage Crack Widths	Reduced Crack
Corrosion Resistance	No Cathodic Corrsion Observed

18 810	Matrix S38 Steel Fibres 38mm	20KG/bag
18 811	Matrix S50 Steel Fibres 50mm	20KG/bag